

INTRODUCTION

The purpose of this project was to inventory the subterranean fauna of the Big Oaks National Wildlife Area (BONWR). This area was formerly the U. S. Army Jefferson Proving Ground (JPG), established in 1940 with the acquisition of 55,320 acres of land in parts of Jefferson, Jennings and Ripley counties (all residents of the area were moved to surrounding areas). The Jefferson Proving Ground was decommissioned in 1995 and was subsequently designated as a national wildlife refuge. Due to the large quantities of unexploded munitions remaining in the area, public use of the BONWR will be limited to certain designated safe areas, primarily in the northeast part of the refuge. The U. S. Air Force still uses an area in the northcentral part of the refuge for live fire exercises.

Big Oaks NWR occurs in the physiographic area called the Muscatatuck Regional Slope (figure 1). Sedimentary rocks of Ordovician, Devonian or Silurian age comprise the bedrock of the region. Multiple streams cross the refuge in a roughly west to east direction (figure 2), all eventually draining into the East Fork of the White River. Five streams have caves along them: (1) Middlefork Creek, (2) Big Creek, (3) Little Graham Creek, (4) Graham Creek, and (5) Otter Creek.

Two major karst areas occur in Indiana (figure 3), with BONWR lying in the southeastern karst area. Limestone is at or near the surface in the refuge and karst topography is locally common, particularly adjacent to streams. The entire area lies behind the Illinoian glacial maxima and caves are found almost exclusively along streams that have dissected the till plain. An overview of the caves of the southeastern Indiana karst was presented by Powell (1959). Although no caves in southeastern Indiana were included, Powell (1961) discussed the regional geology and geography of the caves and karst of the entire state.

Sheldon (1997) reported 33 caves in an inventory of the karst features of the Jefferson Proving Ground. The majority of these caves are under 100 feet in length, with only one containing passages surveyed at over 1,000 feet. Most have relatively large spring entrances created by frost spawling, but immediately beyond the entrance become tight tubular passages. All of the caves are horizontal in nature except for one crevice-like pit that is 29 feet deep. The karst survey embraced the practice of naming the caves after the original landowners, as well as giving each cave a number designation indicating the drainage location. For example, Isaiah Irwin Cave (BC 02) refers to a cave found on the former Irwin property and is in the Big Creek drainage. The names applied by the karst inventory have also been used in this report. All cave survey information and locations are included in Sheldon (1997).

Figure 1. Approximate location of the Big Oaks National Wildlife Refuge in relationship to the regional physiography of Indiana (base map from Powell, 1961).

Figure 2. Map of Big Oaks National Wildlife Refuge showing streams, roads and other features.

Figure 3. Approximate location of the Big Oaks National Wildlife Refuge in relationship to the karst areas of Indiana (base map from Powell, 1961).

REVIEW OF LITERATURE

The dangerous nature of the Jefferson Proving Ground precluded biological exploration of the caves until the area was decommissioned, thus no published references exist to subterranean fauna of JPG. The primary published reference on the cave fauna of southeastern Indiana was presented by Lewis (1983). Obligate subterranean fauna found in the area immediately surrounding the BONWR included the flatworm Sphalloplana weingartneri (Jefferson Co.), isopods Caecidotea jordani (Decatur Co.) and Caecidotea stygia (Jefferson and Jennings counties), amphipod Crangonyx packardi (Jefferson Co.), spider Phanetta subterranea (Jefferson Co.), and beetles Pseudanophthalmus chthonius (Jefferson and Jennings counties) and Pseudanophthalmus undescribed species (Jefferson Co.).

Bowman and Lewis (1984) recognized the populations previously identified as Caecidotea jordani as a distinct species, describing Caecidotea rotunda from caves in Jennings and Decatur counties, Indiana and one cave in southwestern Ohio.

Lewis (1995) prepared a report on the cave fauna of the Crosley State Fish and Wildlife Area in Jennings County, immediately to the west of BONWR. Eleven species of obligate subterranean species were reported from 21 caves sampled: isopod Caecidotea stygia, amphipods Crangonyx packardi, Crangonyx undescribed species, spider Phanetta subterranea, milliped Trichopetalum unicum, springtails Pseudosinella undescribed species, Sinella alata, Sinella cavernarum, Sinella undescribed species, Onychiurus undescribed species, and a fly Spelobia tenebrarum. In other Jennings County caves outside of Crosley were also found the isopod Caecidotea rotunda, spider Porrhomma cavernicola and beetle Pseudanophthalmus chthonius. A total of 14 species of obligate subterranean species were found in Jennings County caves.

METHODS & MATERIALS

During the project 72 trips into 35 caves and 27 trips to 12 wells were conducted between 26 October 2000 and 11 March 2002 for the purpose of sampling the subterranean fauna. The primary methods of sampling were by collecting manually and placing pitfall traps. The pitfalls consisted of four ounce glass specimen jars filled with 70% isopropyl alcohol as a preservative and baited with limburger cheese. Other sampling conducted as the opportunity presented included Karaman-Chappuis extraction of stream gravel and taking leaf litter for Berlese extraction. Wells were baited by placing an uncooked marine shrimp into a pint canning jar with holes punched in the lid to allow entry by invertebrates. The baited jars were lowered onto the bottom of the wells suspended with monofilament fishing line and left in the well for approximately 24 hours. The water from the jars and any invertebrates were drained through a plankton net and the water samples transported back to the laboratory for examination.

Water samples from Karaman-Chappuis extraction were treated in a similar manner, placed in a cooler and transported back to the laboratory where they were placed in petri dishes and examined for living fauna under a dissecting microscope. Litter taken

from the cave was placed in a Berlese funnel, with overhead light/heat extracting the invertebrates into a vial of 70% isopropyl alcohol. Pitfall residues were screened, then transferred into petri dishes for sorting of the fauna under a dissecting microscope. Specimens of each taxon were placed in 3 or 4 dram vials of 70% ethyl alcohol and labeled per cave of origin, state, county, miles to nearest town, date and collector.

ACKNOWLEDGEMENTS

This bioinventory was funded by the Big Oaks National Wildlife Refuge, with additional funding from the Indiana Natural Heritage Program (expedited by Cloyce Hedge). Refuge personnel Joseph Robb, Steve Miller and Teresa Vanosdol-Lewis assisted in many ways, and frequently accompanied us during field work. Jerry Walker is also recognized for his assistance in conducting us safely to caves in areas of particularly great danger due to unexploded munitions.

We also wish to acknowledge the Jefferson Proving Ground Karst Inventory by Ray Sheldon, Keith Dunlap, Bruce Trotter, Jerry Walker and Kevin Wools, which paved the way for the biological inventory of BONWR. The thoroughness of the cave inventory meant that we were able to spend our time looking for fauna instead of trying to locate caves.

The following zoologists are gratefully acknowledged for assistance with identifying specimens collected during this project: Dr. Thomas C. Barr, Jr., Dr. Joseph A. Beatty, Dr. Kenneth Christiansen, Dr. Charles Covell, Mr. Dan Dourson, Dr. John Holsinger, Dr. Jan Klimaszewski, Dr. Robert Lewis, Dr. William Muchmore, Dr. Stewart B. Peck, and Dr. Janet Reid.

FAUNAL LIST

In the following list each species is placed within a Linnaean hierarchical classification. For each species there is a scientific name, original author of the species, a descriptive common name and an ecological classification. The ecological classifications adhere to the following system:

<u>Classification</u>	<u>Abbreviation</u>	<u>Definition</u>
Troglobite	TB	terrestrial, morphologically adapted and restricted to caves, must feed and reproduce in the cave environment
Troglophile	TP	terrestrial, +/- morphologically adapted to caves, not restricted to caves, but can feed and reproduce in the cave environment
Trogloxene	TX	terrestrial, not usually morphologically adapted to caves, usually leaves the cave to either feed or reproduce
Stygobite	SB	aquatic, morphologically adapted and restricted to caves, must feed and reproduce in the cave environment
Stygophile	SP	aquatic, +/- morphologically adapted to caves, not restricted to caves, but can feed and reproduce in the cave environment
Stygoxene	SX	aquatic, not usually morphologically adapted to caves, usually leaves the cave to either feed or reproduce
Accidental	AC	fall or wash into caves with no demonstrable affiliation to the habitat

Accompanying each taxon identified to the species level is a S-rank and G-rank, or State rank of rarity and Global rank of rarity, according to the following system:

<u>Global Rank</u>	<u>Number of sites</u>	<u>Characterization</u>
G1	1-5	critically imperiled
G2	6-20	imperiled
G3	21-100	vulnerable
G4	100+	apparently secure
G5		secure

PHYLUM PLATYHELMINTHES
CLASS TURBELLARIA
ORDER TRICLADIDA

FAMILY KENKIIDAE

Sphalloplana weingartneri Kenk SB Weingartner's cave flatworm

Jefferson Co.: Gray's Cave (MF 01), Kathryn Bayless Cave (MF 02); Jennings Co.: Asa and Sarah Edwards Cave (OC 01); Ripley Co.: Timber Lodge Spring Cave (GC 03), Bernice Chandler Cave (GC 06)

S2/G2; This species is endemic to southern Indiana, where it has been reported from caves in Clark, Crawford, Harrison, Jefferson, Jennings, Lawrence, Orange and Washington counties (Kenk, 1970a; Lewis, 1983; 1996; 1998; 2002).

FAMILY PLANARIIDAE

Phagocata gracilis (Haldeman) SP Slender spring flatworm

Jefferson Co.: Kathryn Bayless Cave (MF 02), small spring below homesite near MF 02, Isaiah Irwin Cave (BC 02), Grace Bear Sycamore Cave (BC 06), Henry Dilk Falls Cave (BC 08), Shirley and Agnes Harsin Cave (BG 09), Three Raiders Monument Cave (BC 11), Martha Beard Fern Cave (BC 14), Edward Prenatt Cave (BC 15), Hunter Jines Cave (BC 16), Sadie and Juanita Jines Cave (BC 18); Jennings Co.: Asa and Sarah Edwards Cave (OC 01); Ripley Co.: Louis Neil Cave (GC 02), Everett Shonk Cave (GC 05), Shonk Farm Cave Spring, Bernice Chandler Cave (GC 06)

S4/G4; This flatworm is ubiquitous in springs of the Midwestern U.S. It is also common in cave streams and in some populations the worms are depigmented and nearly white in color. Hyman (1937) described the unpigmented Phagocata in Donaldson's Cave, Lawrence Co., Indiana as Phagocata subterranea which Kenk (1970b) synonymized with Phagocata gracilis.

Phagocata velata Stringer SX

Ripley Co.: well in Hungry Hollow, Graham Creek drainage, NE ¼ Section 26
S5/G5; This is a common epigeal flatworm that usually occurs in streams or springs across the continental U.S. (Kenk, 1972).

PHYLUM MOLLUSCA
CLASS GASTROPODA
ORDER PULMONATA

FAMILY PHYSIDAE

Physa sp. SX aquatic snail

Jefferson Co.: Edward Prenatt Cave (BC 15)

ORDER SIGMURETHRA

FAMILY DISCIDAE

Anguispira alternata (Say) TX terrestrial snail

Jefferson Co.: Roscoe Wilson Cave (BC 13), Ollie Wilson Cave (BC 19);
S3/G4; This species is reported to have a wide habitat tolerance ranging from woodlands, rocky areas, weedy road and railroad sides and urban areas in vacant lots and gardens (Hubricht, 1985).

Discus patulus (DeShayes) TX disc snail

Jennings Co.: Asa and Sarah Edwards Cave (OC 01)
S4/G4; This species is distributed through the Appalachians and adjacent midwest, usually found associated with upland forests (Hubricht, 1985).

FAMILY POLYGYRIDAE

Inflectarius inflectus (Say) TX Inflected three-toothed snail

Jefferson Co.: Elmer Turner Cave (BC 03), John Sample Cave (BC 04), Dorman Yager Cave (BC 07), Henry Dilk Falls Cave (BC 08), Henry Dilk Falls Cave Annex;
Ripley Co.: Bernice Chandler Cave (GC 06)

S5/G5; This is a common species that occurs in a variety of habitats throughout the southcentral U.S., including frequent use of caves (Hubricht, 1985). Lewis (1998) reported it from caves in Crawford, Orange and Washington counties, Indiana.

Triodopsis tridentata Say TX Common three toothed snail

Jefferson Co.: John Sample Cave (BC 04)
S3/G5; Indiana is on the western edge of the range of this primarily Appalachian species, which usually occurs in upland woods in leaf litter, under logs or rocks (Hubricht, 1985).

Mesodon sp. TX terrestrial snail

Jefferson Co.: Kathryn Bayless Cave (MF 02)
This record is represented by one juvenile specimen.

PHYLUM ARTHROPODA CLASS CRUSTACEA ORDER EUCOPEPODA SUBORDER HARPACTICOIDA

FAMILY CYCLOPIDAE

Acanthocyclops venustoides (Coker) SP copepod crustacean

Jefferson Co.: well, NE ¼ section 7 Big Creek drainage
S4/G4; This species was also reported by Lewis (1998) from a phreatic pool in Bussabarger's Cave, Harrison Co., Indiana.

Acanthocyclops sp., robustus group SP copepod crustacean

Jefferson Co.: Well, Grapevine Branch, section 19

Lewis (1998) reported Acanthocyclops robustus (sensu latu) from eight caves in Harrison and Washington counties, Indiana.

Diacyclops undescribed species A SB copepod crustacean

Ripley Co.: well, SW ¼ 31, Otter Creek drainage

S1/G1; This is an undescribed species known only from this site.

Diacyclops undescribed species B SB copepod crustacean

Jefferson Co.: well, NE ¼ section 7, Big Creek drainage; well, NW ¼ section 18, Graham Creek drainage;

S1/G1; This is an undescribed species known only from these sites.

Diacyclops undescribed species C near yeatmani SB copepod crustacean

Jefferson Co.: Henry Dilk Falls Cave

S1/G1; This is an undescribed species known only from this site. Diacyclops yeatmani and the complex of related undescribed species are known from subterranean habitats, like the interstices of cave stream gravels, drain tiles, wells or the hyporheic zone of streams.

Orthocyclops modestus (Herrick) SP copepod crustacean

Jefferson Co.: Well, Grapevine Branch, section 19

S4/G4; Lewis (1998) reported this copepod from a well in Crawford County and Binkley Cave in Harrison County, Indiana.

Undetermined species SP/SB

Jefferson Co.: Henry Dilk Falls Cave

The material collected from the interstices of stream gravel was represented only by immature specimens that can not be identified.

SUBORDER HARPACTICOIDA

FAMILY CANTHOCAMPTIDAE

Attheyella nordenskioldii (Lilljeborg) SP Nordenskioldi's copepod

Jefferson Co.: well, NW ¼ section 18, Graham Creek drainage

S4/G4; This species was reported by Lewis (1998) from caves in Crawford, Harrison and Washington counties, Indiana.

ORDER OSTRACODA

FAMILY CANDONIDAE

Candona sp. s. latu SB groundwater ostracod

Jefferson Co.: Henry Dilk Falls Cave (BC 08)

S1/G1; This eyeless ostracod is a subterranean species but could not be specifically identified with the limited material available. It could be one of the two

incredibly rare G1 species known to occur in caves of the southcentral Indiana karst (Klie, 1931; Danieolpol and Hartman, 1981) or an undescribed species.

ORDER ISOPODA
SUBORDER ASELLOTA

FAMILY ASELLIDAE

Caecidotea rotunda Bowman and Lewis SB Southeastern Indiana cave isopod

Jefferson Co.: small spring below homesite near MF 02, Charles Bear Cave (BC 01), Mary Spurgin Cave (BC 05), Grace Bear Sycamore Cave (BC 06), John and Daisy Smith Cave (BC 10), Three Raiders Monument Cave (BC 11), Edward Prenatt Cave (BC 15), Glen and Florence Shoots Cave (BC 17), Sadie and Juanita Jines Cave (BC 18); Jennings Co.: Asa and Sarah Edwards Cave (OC 01); Ripley Co.: Thomas and Effie Jessie Cave (LG 02), Lowell Cooper Cave (LG 03), Louis Neil Cave (GC 02), Timber Lodge Spring Cave (GC 03), Bernice Chandler Cave (GC 06)

S2/G2; This species was initially reported by Bowman and Lewis (1984) from 4 caves in Decatur and Jennings counties, Indiana and one cave in southwestern Ohio. Lewis (1995) reported that the isopod could not be found subsequently in two of these localities. Most of the known populations of this rare species are in BONWR.

Caecidotea stygia Packard SB Northern cave isopod

Jefferson Co.: Gray's Cave (MF 01)

S4/G5; This species is ubiquitous in the southcentral Indiana karst, but in the southeastern karst it is found only in the southern part of the region, then replaced by Caecidotea rotunda. It is one of the most wide ranging subterranean members of the genus, recorded from southwestern Ohio, most of Kentucky, southern Illinois and a small area of eastern Missouri (Lewis & Bowman, 1981).

Caecidotea sp. SB subterranean isopod

Jefferson Co.: Kathryn Bayless Cave (MF 02)

Since two species of subterranean isopods occur on Middlefork Creek a male will be required to know with certainty which species is present in this cave.

Caecidotea rotunda occurs in a spring a short distance away on the south side of Middlefork Creek, while Caecidotea stygia occurs downstream in Gray's Cave.

Lirceus fontinalis Rafinesque SX Bluegrass spring isopod

Jefferson Co.: Kathryn Bayless Cave (MF 02), Gray's Cave (MF 01), Charles Bear Cave (BC 01), Isaiah Irwin Cave (BC 02), Henry Dilk Falls Cave (BC 08), Shirley and Agnes Harsin Cave (BG 09), Three Raiders Monument Cave (BC 11), Benjamin Conway Quarry Cave (BC 12), Martha Beard Fern Cave (BC 14), Edward Prenatt Cave (BC 15), Ollie Wilson Cave (BC 19); Jennings Co.: Asa and Sarah Edwards Cave (OC 01); Ripley Co.: Louis Neil Cave (GC 02), Everett Shonk Cave (GC 05), Shonk Farm Cave Spring, Bernice Chandler Cave (GC 06)

S3/G4; Hubricht and Mackin (1949) reported this species from about 45 localities in southern Indiana, Kentucky, southwestern Ohio and northern Tennessee. The isopod is a threshold troglone, primarily occurring in cave springs.

SUBORDER ONISCOIDEA

FAMILY ARMADILLIDIDAE

Cylisticus convexus DeGeer TX Common convex pillbug

Jefferson Co.: Mary Spurgin (BC 05), Dorman Yeager Cave (BC 07), Roscoe Wilson Cave (BC 13); Ripley Co.: Mary Kirk Cave (LG 01)

This species is a common threshold troglone. Lewis (1998) found it in caves in Crawford, Harrison and Washington counties, Indiana.

FAMILY LIGIIDAE

Ligidium elrodi (Packard) TP/TX Elrod Cave terrestrial isopod

Jefferson Co.: Edward Prenatt Cave (BC 15); Ripley Co.: Bernice Chandler Cave (GC 06)

S4/G4; Described from Elrod Cave, Orange Co., Indiana by Packard (1873), this species was redescribed by Schultz (1970), who also reported it in caves in Tennessee, Georgia and Virginia. In Indiana it occurs in caves in Crawford, Harrison, Lawrence, Orange and Washington counties (Lewis, 1998), where it is partial to very moist detritus.

FAMILY PORCELLIONIDAE

Trachelipus rathkei (Brandt) TX Rathke's terrestrial isopod

Jefferson Co.: Gray's Cave (MF 01), Kathryn Bayless Cave (MF 02), Charles Bear Cave (BG 01), Isaiah Irwin Cave (BC 02), Mary Spurgin Cave (BC 05), Grace Bear Sycamore Cave (BC 06); Ripley Co.: Timber Lodge Spring Cave (GC 03), Bernice Chandler Cave (GC 06),

SE/G5; This is an introduced European species. It is a common threshold troglone and was reported from caves in Clark, Crawford, Harrison, Jennings, Orange and Washington counties (Lewis, 1995; 1996; 1998).

FAMILY TRICHONISCIDAE

Haplophthalmus danicus Budde-lunde TP terrestrial isopod

Jefferson Co.: Mary Spurgin Cave (BC 05), Three Raiders Monument Cave (BC 11), Roscoe Wilson Cave (BC 13),

SE/G4; This species was reported from five Indiana counties. Lewis (1996; 1998) reported it from caves in Clark, Crawford, Harrison and Washington counties. It is an introduced European species that is widespread in the eastern U.S.

ORDER AMPHIPODA

FAMILY CRANGONYCTIDAE

Crangonyx anomalous Hubricht SX Anomalous amphipod

Jennings Co.: Well, Otter Creek drainage, SW ¼ Section 31

S1/G3; This species is an inhabitant of springs and spring streams in southeastern Indiana, northcentral Kentucky and southwestern Ohio. It regularly occurs with Crangonyx setodactylus and sometimes Synurella dentata, but is much less common (Holsinger, 1972).

Crangonyx forbesi Hubricht and Mackin TX/TP Forbe's spring amphipod

Jefferson Co.: Gray's Cave (MF 01), Kathryn Bayless Cave (MF 02), spring across from MF 02, Isaiah Irwin Cave (BC 02), Henry Dilk Waterfall Cave (BC 08), Benjamin Conway Quarry Cave (BC 12); Ripley Co.: Louis Neil Cave (GC 02)

S4/G4; This species is a common spring inhabitant or troglophile throughout its range in the eastern U.S. (Zhang, 1997)

Crangonyx packardi Smith SB Packard's groundwater amphipod

Jefferson Co.: Gray's Cave (MF 01), Charles Bear Cave (BC 01), Mary Spurgin Cave (BC 05), Henry Dilk Falls Cave (BC 08), Hunter Jines Cave (BC 16), Sadie and Juanita Jines Cave (BC 18); Jennings Co.: Elizabeth Stout Cave (GC 01); Ripley Co.: Louis Neil Cave (GC 02), Timber Lodge Spring Cave (GC 03), Bernice Chandler Cave (GC 06),

S3/G3; This species, first described from a well in Orleans, Orange Co., Indiana, is now known to occur from Indiana west to Kansas (Zhang, 1997). In the HNF, when Crangonyx packardi is found with Crangonyx undescribed species #1, the former usually inhabits gravel interstices while the latter roams the surface of the substrate. When found by itself, Crangonyx packardi occurs in drip pools and ephemeral streams. Lewis (1998) found it a meter deep in gravel interstices of the Blue River.

Crangonyx setodactylus Bousfield SX Hair-clawed amphipod

Jefferson Co.: Gray's Cave (MF 01), Isaiah Irwin Cave (BC 02), Elmer Turner Cave (BC 03), Edward Prenatt Cave (BC 15), well (Big Creek drainage) in section 7, well (Big Creek drainage) center line sections 7/8; Ripley Co.: Louis Neil Cave (GC 02)

S4/G4; This species is usually associated with cold-water habitats, particularly in springs and spring runs in the Bluegrass region. It occurs from Ontario south to Kentucky (Holsinger, 1972).

Crangonyx undescribed species SB Lewis' cave amphipod

Jefferson Co.: Henry Dilk Falls Cave (BC 08), Bernice Chandler Cave (GC 06),
S2/G2; This species has been reported primarily from caves in the southeastern Indiana karst, as well as two localities in adjacent Kentucky. (Zhang, 1997). In caves of BONWR it is less common than Crangonyx packardi, with which it co-occurs.

Synurella dentata Hubricht SX Toothed spring amphipod

Jefferson Co.: Three Raiders Monument Cave (BC 11)
S4/G4; This species has a range similar to Crangonyx anomalus, in southwestern Ohio, southeastern Indiana and the Bluegrass region of Kentucky, extending to a population from northcentral Tennessee. It usually occurs in springs (Holsinger, 1972).

FAMILY GAMMARIDAE

Gammarus minus Say SX Lesser spring amphipod

Ripley Co.: Everett Shonk Cave (GC 05)
S4/G5; This species occurs in caves and springs over much of the eastern U.S. In the southcentral Indiana karst it is ubiquitous in springs and in some caves has

depigmented, small-eyed populations. In the southeastern Indiana karst it is very unusual.

ORDER DECAPODA

FAMILY CAMBARIDAE

Cambarus laevis Faxon SP Karst crayfish

Jefferson Co.: Gray's Cave (MF 01), Kathryn Bayless Cave (MF 02), Isaiah Irwin Cave (BC 02), Elmer Turner Cave (BC 03), Henry Dilk Falls Cave (BC 08), Three Raiders Monument Cave (BC 11), Edward Prenatt Cave (BC 15), Hunter Jines Cave (BC 16); Jennings Co.: Asa and Sarah Edwards Cave (OC 01); Ripley Co.: Louis Neil Cave (GC 02), Bernice Chandler Cave (GC 06)

S3/G4; This species occurs in caves of both the southcentral and southeastern Indiana karst areas.

CLASS ARACHNIDA ORDER ARANEAE

FAMILY AGELENIDAE

Calymmaria cavicola (Banks) TX Cave funnel-web spider

Jefferson Co.: Gray's Cave (MF 01), John Sample Cave (BC 04)

S2/G4; This spider is widespread in the southeastern U.S. but is sporadic in its occurrence.

Cicurina pallida Keyserling TP Pallid funnel-web spider

Jefferson Co.: John Sample Cave (BC 04), Mary Spurgin Cave (BC 05), John and Daisy Smith Cave (BC 10), Edward Prenatt Cave (BC 15), Ollie Wilson Cave (BC 19), Bernice Chandler Cave (GC 06)

S3/G4; This species is found from Indiana east to the Atlantic states (Chamberlin & Ivie, 1940). It has been reported from caves in Crawford, Harrison, Orange (Lewis, 1998), Monroe (Banta, 1907), Clark (Lewis, 1996) and Jennings counties (Lewis, 1995).

Coras lamellosis (Keyserling) TX funnel-web spider

Jefferson Co.: Gray's Cave (MF 01), Kathryn Bayless Cave (MF 02), Grace Bear Sycamore Cave (BC 06)

S4/G4; This species frequents bluffs and is an occasional threshold troglodene.

Cybaeus silicis Barrows TX funnel-web spider

Ripley Co.: Bernice Chandler Cave (GC 06)

S4/G4; This species occurs across the eastern U.S. (Chamberlin and Ivie, 1932).

Wadotes sp. TX funnel-web spider

Jefferson Co.: Charles Bear Cave (BG 01), Mary Spurgin Cave (BC 05)

FAMILY LINYPHIIDAE

Eperigone maculata (Banks) TP sheet-web spider

Jefferson Co.: John Sample Cave (BC 04)

S4/G4; This species was reported by Lewis (1998) from caves in Harrison and Orange counties, Indiana.

Phanetta subterranea (Emerton) TB Subterranean sheet-web spider

Jefferson Co.: Gray's Cave (MF 01), Elmer Turner Cave (BC 03), Martha Beard Fern Cave (BC 14); Jennings Co.: Asa and Sarah Edwards Cave (OC 01); Ripley Co.: Louis Neil Cave (GC 02), Timber Lodge Spring Cave (GC 03), Bernice Chandler Cave (GC 06)

S4/G5; This tiny spider is ubiquitous in Indiana caves, where it has been found in Clark (Lewis, 1983; 1996), Decatur, Jefferson (Lewis, 1983; 2001), Jennings, Ripley (Lewis, 1995; 2001), Orange (Lewis, 1994), and Monroe counties (Banta, 1907), as well as those listed above. Originally described from Wyandotte Cave, Crawford Co., the species was redescribed by Millidge (1984) and reported from a range between Alabama and Pennsylvania, west to Indiana. Peck & Lewis reported this species from Illinois and Missouri.

Oreonetides undescribed species TB Sheet-web spider

Jefferson Co.: Gray's Cave (MF 01); Ripley Co.: Louis Neil Cave (GC 02)

S1/G1; This species is known only these two caves in the Big Oaks National Wildlife Area in the southeastern Indiana karst and from the Tincher Special Karst Area of the Hoosier National Forest. Both of these areas are in the East Fork of White River drainage.

FAMILY LYCOSIDAE

Pirata sedentarius Montgomery TX Sedentary pirate wolf spider

Jefferson Co.: Charles Bear Cave (BG 01), Mary Spurgin Cave (BC 05), Roscoe Wilson Cave (BC 13), Edward Prenatt Cave (BC 15),

S5/G5; This species occurs from southern Canada, across the U.S. into Mexico and the Caribbean islands (Wallace and Exline, 1978).

FAMILY PISAURIDAE

Dolomedes vittatus Walkenaer TX Nursery web spider

Jefferson Co.: Isaiah Irwin Cave (BC 02)

S4/G4; Carico (1973) reported this spider from many sites in the eastern U.S., but none in Indiana, almost certainly an artifact of lack of collecting. Lewis (1998) found this species in a cave in Harrison Co., Indiana.

Dolomedes scriptus Hentz TX Lined nursery web spider

Jefferson Co.: John Sample Cave (BC 04), Dorman Yeager Cave (BC 07)

S4/G4; Carico (1973) reported this species from numerous sites in the eastern U.S., but only two in Indiana, presumably again an artifact of lack of collecting. Carico

reported this species was usually associated with moderate to fast running streams. Lewis (1998) reported it as a threshold troglodene from caves in Crawford, Harrison and Orange counties, Indiana.

FAMILY TETRAGNATHIDAE

Meta ovalis Gertsch TP American cave orb weaver spider

Jefferson Co.: Gray's Cave (MF 01), Charles Bear Cave (BG 01), Isaiah Irwin Cave (BC 02), Elmer Turner Cave (BC 03), John Sample Cave (BC 04), Mary Spurgin Cave (BC 05), Grace Bear Sycamore Cave (BC 06), Dorman Yeager Cave (BC 07), Henry Dilk Falls Cave (BC 08), Shirley and Agnes Harsin Cave (BG 09), John and Daisy Smith Cave (BC 10), Edward Prenatt Cave (BC 15), Sadie and Juanita Jines Cave (BC 18), Ollie Wilson Cave (BC 19); Jennings Co.: Elizabeth Stout Cave (GC 01), Asa and Sarah Edwards Cave (OC 01) S4/G5; This species is ubiquitous in caves of the eastern U.S. (Marusik and Koponen, 1992). It has been recorded from essentially every county in Indiana that has caves (Blatchley, 1897; Banta, 1907; Lewis, 1994; 1995; 1996; 1998; 2001).

FAMILY THERIDIIDAE

Achaearanea tepidariorum (Koch) TX American house spider

Jefferson Co.: Henry Dilk Falls Cave (BC 08), Henry Dilk Falls Annex Cave S5/G5; This species is ubiquitous on cliffs, where it occurs in suitable habitat around cave entrances.

ORDER PSEUDOSCORPIONIDA

FAMILY CHERNETIDAE

Hesperocheles mirabilis (Banks) TB Eastern cave pseudoscorpion

Jefferson Co.: Elmer Turner Cave (BC 03), Roscoe Wilson Cave (BC 13), S2/G3; This species is frequently associated with mouse or woodrat nests, where it is found in caves in the southeastern U.S. (Muchmore, 1974). In Indiana it has been reported from caves in Crawford, Harrison, Jefferson and Washington counties (Lewis, 1998; 2002).

FAMILY CHTHONIIDAE

Chthonius sp. TP/TX pseudoscorpion

Jefferson Co.: John Sample Cave (BC 04), Roscoe Wilson Cave (BC 13); Ripley Co.: Bernice Chandler Cave (GC 06)

Previous records to cave pseudoscorpions (Lewis, 1995; 1998) have referred to Chthonius virginicus, but this taxon is so confused at present that it is best to leave it as Chthonius sp. until the group is revised (Muchmore, in litt.).

Apochthonius sp. TP/TX pseudoscorpion

Jefferson Co.: John Sample Cave (BC 04)

ORDER OPILIONES

FAMILY PHALANGIIDAE

Leiobunum elegans Weed TX harvestman

Jefferson Co.: Gray's Cave (MF 01); Ripley Co.: Bernice Chandler Cave (GC 06)
S4/G5; This species is a woodland harvester that commonly over-winters in caves (Bishop, 1949), sometimes reported under the junior synonym Leiobunum bicolor. Lewis (1998) reported it from caves in Crawford, Harrison and Orange counties.

CLASS DIPLOPODA ORDER CHORDEUMATIDA

FAMILY CLEIDOGONIDAE

Cleidogona sp. TX milliped

Jefferson Co.: John Sample Cave (BC 04), Hunter Jines Cave (BC 16)

ORDER POLYDESMIDA

FAMILY POLYDESMIDAE

Scytonotus granulatus (Say) TX Granulated milliped

Jefferson Co.: Elmer Turner Cave (BC 03), Mary Spurgin Cave (BC 05); Ripley Co.: Bernice Chandler Cave (GC 06)

S3/G4; This species is a frequent troglaxene in Indiana, where it is meeting increasing competition with exotic species in both cave and epigeal habitats.

ORDER POLYZONIIDA

FAMILY POLYZONIIDAE

Petaserpes sp. TX polyzoniid milliped

Jefferson Co.: Dorman Yeager Cave (BC 07)

ORDER SPIROSTREPTIDA

FAMILY CAMBALIDAE

Cambala minor Bollman TP Lesser cave-loving milliped

Jefferson Co.: Charles Bear Cave (BC 01), John Sample Cave (BC 04), Henry Dilk Falls Cave (BC 08), Henry Dilk Waterfall Annex Cave (BC 08), Three Raiders Monument Cave (BC 11); Ripley Co.: Mary Kirk Cave (LG 01),

S3/G4; Shelley (1979) reported this species from about 60 localities from Virginia to Oklahoma. It is a frequent troglophile with many of the known localities being from caves. In Indiana it has been reported from caves in the southeastern karst (Lewis, 1995;1996; 2001) and the southcentral karst (Lewis, 1998).

ORDER JULIDA

FAMILY JULIDAE

Ophiulus pilosus (Newport) TX/TP Garden milliped

Ripley Co.: Bernice Chandler Cave (GC 06)

SE/GE; This is an exotic species, probably originating in Europe. In Indiana, it has also been found in caves in Harrison, Jennings, Orange and Ripley counties (Lewis, 1994; 1995; 2001).

CLASS INSECTA ORDER COLLEMBOLA

FAMILY ENTOMOBRYIDAE

Pseudosinella fonsa Christiansen TB Fountain cave springtail

Jefferson Co.: Dorman Yeager Cave (BC 07)

S2/G2; This species is quite rare, usually known from single specimens taken at each locality. Described from a cave in Clark County (Christiansen and Bellinger, 1996), Lewis (1998) subsequently recorded it from caves in Crawford, Harrison and Washington counties. It is also known from one cave in southwestern Ohio.

Pseudosinella undescribed species near fonsa TB springtail

Jefferson Co.: Kathryn Bayless Cave (MF 02); Ripley Co.: Bernice Chandler Cave (GC 06)

S1/G1; This undescribed species is poorly understood at the moment pending delineation and description, but is endemic to the Indiana karst.

Sinella alata Christiansen TB Indiana cave springtail

Jefferson Co.: Gray's Cave (MF 01), Kathryn Bayless Cave (MF 02); Ripley Co.: Louis Neil Cave (GC 02)

S3/G3; This species is endemic to Indiana (Christiansen and Bellinger, 1998c), where it has been found in caves in Clark, Crawford, Harrison, Jefferson, Jennings, Lawrence, Monroe, Orange, Ripley and Washington counties (Lewis, 1983; 1994; 1995; 1998).

Sinella cavernarum (Packard) TB Cavernicolous springtail

Jefferson Co.: Shirley and Agnes Harsin Cave (BG 09),

S3/G3; Christiansen (1960) reported this collembolan from caves in Indiana, Kentucky, Tennessee, Missouri and Pennsylvania, as well as an endogenous grave collection in the District of Columbia. In Indiana it has been reported from caves in Clark, Crawford, Harrison, Jennings and Washington counties (Lewis, 1995; 1996; 1998).

FAMILY HYPOGASTRURIDAE

Hypogastrura denticulata species complex TX Toothed springtail

Jefferson Co.: John Sample Cave (BC 04), Ollie Wilson Cave (BC 19); Ripley Co.: Bernice Chandler Cave (GC 06)

These records are assigned to this complex of species that remains taxonomically confused (Christiansen & Bellinger, 1998a).

Hypogastrura sp. TX springtail

Jefferson Co.: Roscoe Wilson Cave (BC 13)

FAMILY ISOTOMIDAE

Folsomia candida Willem TP White springtail

Jefferson Co.: John Sample Cave (BC 04)

S3/G4; This species has been reported from caves in Missouri (Gardner, 1986; Peck and Lewis, 1978), Illinois (Peck and Lewis, 1978), and Arkansas (McDaniel and Smith, 1978; Craig, 1977). Lewis (1998) reported it from 17 Indiana caves in Crawford, Harrison, Orange and Washington counties.

Folsomia stella Christiansen and Bellinger TX Star springtail

Jefferson Co.: John Sample Cave (BC 04)

S4/G4; The taxonomy of this species is somewhat confused at present but as interpreted currently it is a common species. Lewis (1998) reported it from caves in Crawford, Harrison, Orange and Washington counties in Indiana.

Isotoma notabilis Schafter TX Remarkable springtail

Jefferson Co.: Roscoe Wilson Cave (BC 13),

S4/G4; This is the largest and most common Isotoma species in North America. It is known from caves in five states and surface collections in 14 states, Nova Scotia and British Columbia (Christiansen & Bellinger, 1998b).

Isotoma (Desoria) undescribed species TX springtail

Jefferson Co.: Elmer Turner Cave (BC 03)

Isotoma undescribed species near caeruleatra TX springtail

Jefferson Co.: John Sample Cave (BC 04)

FAMILY TOMOCERIDAE

Tomocerus bidentatus Folsom TP Two-toothed springtail

Ripley Co.: Bernice Chandler Cave (GC 06)

S3/G3; This species is slightly troglomorphic and is known from primarily caves, although a few surface records exist (Christiansen, 1982). It has been reported in Indiana from caves in Crawford, Harrison, Jennings and Washington counties (Lewis, 1995; 1998).

Tomocerus flavescens (Tullberg) TP Golden springtail

Jefferson Co.: Henry Dilk Waterfall Cave (BC 08),

S3/G4; This species has been recorded in caves in Clark, Crawford, Harrison, Jennings, Orange and Washington counties, Indiana (Lewis, 1994; 1995; 1996; 1998). It occurs in caves through much of the U.S. and is also known from many surface records (Christiansen & Bellinger, 1998c).

Tomocerus lamelliferus Mills TX Lamellate springtail

Jefferson Co.: John Sample Cave (BC 04)
S4/G4; This species occurs across the U.S., but is mostly known from the east, where it is an occasional cavernicole Christiansen & Bellinger, 1998c).

FAMILY ONYCHIURIDAE

Onychiurus undescribed species near casus TB springtail

Ripley Co.: Bernice Chandler Cave
S1/G1; Many undescribed species of cavernicolous springtails occur in this genus.

Onychiurus undescribed species near parvicornis TP springtail

Jefferson Co.: Roscoe Wilson Cave (BC 13)
S1/G1; This species is known only from this cave.

Onychiurus sp. TP/TX springtail

Jefferson Co.: John and Daisy Smith Cave (BC 10)

FAMILY SMINTHURIDAE

Arrhopalites pygmaeus (Wankel) TP/TB Pygmy springtail

Jefferson Co.: Elmer Turner Cave (BC 03); Ripley Co.: Bernice Chandler Cave (GC 06)

S3/G4; This species has been reported from some surface collections suggestive of an endogenous, rather than epigeal existence, and Christiansen (1966) stated that it was a troglotic species. The species occurs in Europe and North America (Christiansen, 1982; Christiansen and Bellinger, 1998d). In Indiana it has been reported from caves in Clark, Crawford, Harrison, Jennings, Orange, and Washington counties (Lewis, 1994; 1995; 1998).

Arrhopalites undescribed species near caedus TB undescribed springtail

Jefferson Co.: Ollie Wilson Cave (BC 19)
S1/G1; This species is known only from this locality. Many troglotes occur within this genus.

Arrhopalites undescribed species near pygmaeus TB undescribed springtail

Jefferson Co.: Gray's Cave (MF 01)
S1/G1; This species is known only from this locality.

Sminthurides hyogrammae Pedigo TX springtail

Jefferson Co.: John Sample Cave (BC 04)
S1/G1; This rare species was previously known from the type-locality in Tippecanoe Co., two other Indiana surface records, a cave in Harrison Co. (Lewis, 1998) and one other site in Iowa (Christiansen and Bellinger, 1998d).

Sminthurides sp. TX springtail

Jefferson Co.: John and Daisy Smith Cave (BC 10)

ORDER ORTHOPTERA

FAMILY GRYLLACRIDIDAE

Ceuthophilus meridionalis Scudder TX Southern cave cricket

Jefferson Co.: Henry Dilk Waterfall Cave (BC 08); Ripley Co.: Bernice Chandler Cave (GC 06)

S4/G4; This species co-occurs with Ceuthophilus stygius and is found in clusters containing both species. In Indiana it has been reported from caves in Crawford, Harrison, Orange and Washington counties (Lewis, 1998).

Ceuthophilus stygius (Scudder) TX Stygian cave cricket

Jefferson Co.: Gray's Cave (MF 01), Charles Bear Cave (BG 01), Isaiah Irwin Cave (BC 02), Elmer Turner Cave (BC 03), John Sample Cave (BC 04), Mary Spurgin Cave (BC 05), Grace Bear Sycamore Cave (BC 06), Dorman Yeager Cave (BC 07), Henry Dilk Falls Cave (BC 08), Shirley and Agnes Harsin Cave (BG 09), Roscoe Wilson Cave (BC 13), Edward Prenatt Cave (BC 15); Jennings Co.: Elizabeth Stout Cave (GC 01); Ripley Co.: Thomas and Effie Jessie Cave (LG 02), Louis Neil Cave (GC 02), Heron Hole Cave (GC 04), Bernice Chandler Cave (GC 06), Alexander Thompson Pit (GC 07)

S4/G4; This is the common cave cricket in most caves of Indiana. Outside of Indiana it has been reported from Ohio, Kentucky and Tennessee (Hubbell, 1936).

ORDER COLEOPTERA

FAMILY CARABIDAE

Atranus pubescens Dejean TX Pubescent ground beetle

Ripley Co.: Mary Kirk Cave (LG 01)

S4/G4; This and the following species are common in eastern U.S. caves (Barr, 1964).

Platynus tenuicollis (LeConte) TP/TX Slender ground beetle

Jefferson Co.: Kathryn Bayless Cave (MF 02), Henry Dilk Falls Cave (BC 08), Ollie Wilson Cave (BC 19); Ripley Co.: Bernice Chandler Cave (GC 06)

S5/G5; This beetle is a common troglophile in the eastern U.S. (Barr, 1964).

FAMILY CRYPTOPHAGIDAE

Undetermined species TX

Ripley Co.: Heron Hole Cave

FAMILY LEIODIDAE

Catops gratiosus Blanchard TP round fungus beetle

Jefferson Co.: Elmer Turner Cave (BC 03), Dorman Yeager Cave (BC 07), John and Daisy Smith Cave (BC 10), Three Raiders Monument Cave (BC 11), Roscoe Wilson Cave (BC 13), Hunter Jines Cave (BC 16); Ripley Co.: Bernice Chandler Cave (GC 06)

S3/G4; This widespread troglophile has also been recorded in Indiana from caves in Clark, Crawford, Harrison, Jefferson, Orange, Ripley and Washington counties (Lewis, 1996; 1998; 2002).

FAMILY STAPHYLINIDAE

Aleochara castaneipennis Mannersheim TX rove beetle

Jefferson Co.: John and Daisy Smith Cave (BC 10)

S4/G4; This species occasionally occurs in caves. The larvae of this genus are ectoparasites of the pupae of flies (Klimaszewski and Peck, 1986).

Aleochara lucifuga (Casey) TP Unpigmented rove beetle

Jefferson Co.: Gray's Cave (MF 01), Dorman Yager Cave (BC 07); Ripley Co.: Louis Neil Cave (GC 02), Bernice Chandler Cave (GC 06)

S3/G4; This species is known only from caves and one record of a groundhog burrow (Klimaszewski and Peck, 1986). In Indiana it has been recorded from caves in Crawford, Harrison, Orange and Washington counties (Lewis, 1998).

Atheta annexa Klimaszewski TP rove beetle

Jefferson Co.: John and Daisy Smith Cave (BC 10)

S1/G4; This species is known over the eastern U.S., where it is found in caves associated with organic debris, raccoon dung and woodrat nests (Klimaszewski and Peck, 1986).

Atheta troglophila Klimaszewski TP Troglophilic rove beetle

Jefferson Co.: Elmer Turner Cave (BC 03), Henry Dilk Falls Cave (BC 08), John and Daisy Smith Cave (BC 10); Ripley Co.: Bernice Chandler Cave (GC 06)

S2/G4; Although classified as a troglophile, this species is known only from caves, primarily in the Interior Low Plateaus and Ozarks. It occurs on carrion, dung, leaf litter and other debris (Klimaszewski and Peck, 1986).

Atheta ventricosa Bernhauer TX rove beetle

Jefferson Co.: Henry Dilk Falls Cave (BC 08)

S4/G4

Ilyobates puberulus (Casey) TX rove beetle

Ripley Co.: Bernice Chandler Cave (GC 06)

S1/G2; This is the first record of this species in Indiana, which is known from Missouri to Pennsylvania. Four of the known records are from caves (Klimaszewski and Peck, 1986).

Lathrobium sp. TX rove beetle

Ripley Co.: Bernice Chandler Cave (GC 06)

Lesteva pallipes (LeConte) TX rove beetle

Jefferson Co.: Gray's Cave (MF 01), Elmer Turner Cave (BC 03), Henry Dilk Falls Cave (BC 08), Three Raiders Monument Cave (BC 11), Roscoe Wilson Cave (BC

13), Martha Beard Fern Cave (BC 14), Hunter Jines Cave (BC 16), Ollie Wilson Cave (BC 19); Ripley Co.: Louis Neil Cave (GC 02), Timber Lodge Spring Cave (GC 03), Heron Hole Cave (GC 04), Bernice Chandler Cave (GC 06)

S4/G4; This beetle is common in cave riparian habitats and leaf litter in pit bottoms. Lewis (1998) reported it from caves in Crawford, Harrison, Orange and Washington counties.

Tachinus fumipennis (Say) TX rove beetle

Jefferson Co.: John and Daisy Smith Cave (BC 10)

S4/G4

ORDER LEPIDOPTERA

FAMILY NOCTUIDAE

Scoliopteryx libatrix (Linnaeus) TX Herald moth

Jefferson Co.: Gray's Cave (MF 01), Charles Bear Cave (BG 01), Isaiah Irwin Cave (BC 02), Dorman Yeager Cave (BC 07), Sadie and Juanita Jines Cave (BC 18); Jennings Co.: Elizabeth Stout Cave (GC 01); Ripley Co.: Bernice Chandler Cave (GC 06)

S5/G5; This species over-winters in caves.

Undetermined species TX moth

Jefferson Co.: Gray's Cave (MF 01), Isaiah Irwin Cave (BC 02)

These records represent the same noctuid taxon, but will have to be sent to a specialist for further identification (Covell, personal communication).

ORDER DIPTERA

FAMILY CULICIDAE

Anopheles punctipennis (Say) TX mosquito

Jefferson Co.: Gray's Cave (MF 01), Charles Bear Cave (BC 01), Isaiah Irwin Cave (BC 02), Mary Spurgin Cave (BC 05), Grace Bear Sycamore Cave (BC 06), Dorman Yeager Cave (BC 07); Jennings Co.: Elizabeth Stout Cave (GC 01), Asa and Sarah Edwards Cave (OC 01); Ripley Co.: Heron Hole Cave (GC 04)

S5/G5; Mosquitos occur in many Indiana caves, where inseminated females spend the winter.

FAMILY HELEOMYZIDAE

Amoebaleria defessa (Osten-Sacken) TX heleomyzid fly

Jefferson Co.: Dorman Yeager Cave (BC 07),

S4/G4; There is some question as to the validity of a second species, Amoebaleria sackeni, occurring in caves, but this remains unsolved and all records herein are lumped under defessa. This species occurs on the walls and ceilings of caves.

Aecothea specus (Aldrich) TX heleomyzid fly

Jefferson Co.: Gray's Cave (MF 01); Ripley Co.: Louis Neil Cave (GC 02), Bernice Chandler Cave (GC 06)

S4/G4; This species occurs on the walls and ceilings of caves where it is the frequent associate of Amoebaleria. It has been reported from caves in Clark, Crawford, Greene, Harrison, Jefferson, Jennings, Orange and Washington counties, Indiana (Busacca, 1975; Lewis, 1995; 1996; 1998).

Heleomyza brachypterna (Loew) TX heleomyzid fly

Jefferson Co.: Henry Dilk Falls Cave (BC 08)

S4/G4; This and the above two species frequently occur together on the walls and ceilings of caves.

FAMILY MYCETOPHILIDAE

Macrocera nobilis TP Cavernicolous fungus gnat

Jefferson Co.: Gray's Cave (MF 01), Henry Dilk Falls Cave (BC 08)

S4/G4; This is a widespread fungus gnat that is commonly found on webs under rocks and in crevices in caves. This species occurs across the eastern U.S.

Mycetophilid species TP

Jefferson Co.: Gray's Cave (MF 01), Elmer Turner Cave (BC 03), Dorman Yeager Cave (BC 07), Henry Dilk Falls Cave (BC 08), John and Daisy Smith Cave (BC 10); Ripley Co.: Louis Neil Cave (GC 02), Bernice Chandler Cave (GC 06)

The current confusion present in the taxonomy of this group precludes specific identification.

FAMILY PHORIDAE

Megaselia cavernicola Brues TP Cave hump-backed fly

Jefferson Co.: Gray's Cave (MF 01), Elmer Turner Cave (BC 03), Dorman Yeager Cave (BC 07), Henry Dilk Falls Cave (BC 08), John and Daisy Smith Cave (BC 10), Three Raiders Monument Cave (BC 11), Ollie Wilson Cave (BC 19); Ripley Co.: Louis Neil Cave (GC 02), Timber Lodge Spring Cave (GC 03), Bernice Chandler Cave (GC 06)

S5/G5; This species is ubiquitous in caves of the eastern U.S. and has also been reported from surface collections (Borgmeier, 1965). It probably occurs in nearly every cave in Indiana that is of any length (Lewis, 1994; 1995; 1996; 1998; 2001) and comes to baited pitfalls in abundance.

FAMILY PSYCHODIDAE

Psychodid species TP Moth fly

Jefferson Co.: Gray's Cave (MF 01), Elmer Turner Cave (BC 03), Dorman Yeager Cave (BC 07), Henry Dilk Falls Cave (BC 08); Ripley Co.: Louis Neil Cave (GC 02), Bernice Chandler Cave (GC 06)

The taxonomy of this group precludes specific identification.

FAMILY SPHAEROCERIDAE

Spelobia tenebrarum (Aldrich) TB Cave dung fly

Jefferson Co.: Gray’s Cave (MF 01), Kathryn Bayless Cave (MF 02), Elmer Turner Cave (BC 03), John Sample Cave (BC 04), Dorman Yeager Cave (BC 07), Henry Dilk Falls Cave (BC 08), Shirley and Agnes Harsin Cave (BG 09), Three Raiders Monument Cave (BC 11), Martha Beard Fern Cave (BC 14), Ollie Wilson Cave (BC 19); Jennings Co.: Asa and Sarah Edwards Cave (OC 01); Ripley Co.: Louis Neil Cave (GC 02), Timber Lodge Spring Cave (GC 03), Bernice Chandler Cave (GC 06)

S5/G5; This fly is ubiquitous in Indiana caves (Blatchley, 1897; Banta, 1907; Lewis, 1994; 1995; 1996; 1998; 2001). It is particularly common on raccoon dung and has been found in essentially every cave in Indiana where baited pitfalls have been placed. The species occurs in caves across the eastern U.S. and is a mildly troglomorphic troglobite (Marshall & Peck, 1985).

ORDER HYMENOPTERA

FAMILY BRACONIDAE

Unidentified species TP wasp

Jefferson Co.: John and Daisy Smith Cave (BC 10),

The state of confusion present in the taxonomy of this group precludes specific identification. These wasps are parasitic on the larvae of cave flies.

ORDER SIPHONAPTERA

FAMILY CERATOPHYLLIDAE

Orchopeas caedens (Jordan) PS flea

Jefferson Co.: Henry Dilk Falls Cave (BC 08), Three Raiders Monument Cave (BC 11)

S5/G5; This and the flea listed below were found in pitfalls traps and are typically ectoparasites of mice. Mouse droppings are commonly found in and around the pitfalls, where they are presumably feeding on the cheese bait.

FAMILY CTENOPHTHALMIDAE

Ctenophthalmus pseudagyrtes Baker PS flea

Ripley Co.: Bernice Chander Cave (GC 06)

S5/G5

PHYLUM CHORDATA
CLASS OSTEICHTHYES
ORDER CYPRINIFORMES

FAMILY CYPRINIDAE

Notropis sp. AC shiner

Jefferson Co.: Edward Prenatt Cave (BC 15),

This record refers to the “bass minnows” of Sheldon (1997) noted in this cave.

**CLASS AMPHIBIA
ORDER CAUDATA**

FAMILY PLETHODONTIDAE

Desmognathus fuscus fuscus TX Northern dusky salamander

Jefferson Co.: Martha Beard Fern Cave (BC 14), Hunter Jines Cave (BC 16);

Ripley Co.: Louis Neil Cave (GC 02)

S4/G5; In Indiana this salamander usually occurs in the mouths of caves and in springs (Minton, 2001).

Eurycea longicauda longicauda (Green) TX/TP Longtail salamander

Jefferson Co.: Henry Dilk Falls Cave (BC 08), Ollie Wilson Cave (BC 19);
Ripley Co.: Mary Kirk Cave, (LG 01), Louis Neil Cave (GC 02), Bernice Chandler Cave (GC 06)

S5/G5; This species is usually associated with rocky streams and is frequently associated with springs (Minton, 2001). It was also noted by Minton that the Longtail salamander frequently occurred near the mouths of caves. In the HNF this salamander was sometimes found in significant numbers rather deep into the dark zone of caves. Its overall range encompasses much of the eastern U.S.

Eurycea lucifuga Rafinesque TP Cave salamander

Jefferson Co.: Gray's Cave (MF 01), Henry Dilk Falls Cave (BC 08), Edward Prenatt Cave (BC 15); Ripley Co.: Thomas and Effie Jessie Cave (LG 02), Louis Neil Cave (GC 02), Timber Lodge Spring Cave (GC 03), Bernice Chandler Cave (GC 06), Alexander Thompson Pit (GC 07)

S4/G5; Most of the records for the Cave salamander are from springs, spring-fed brooks or caves, but have also been found under stones on dry, open hillsides, under trash in an open field, and in suburban yards (Minton, 2001). Compared to the Longtail salamander, the range of the Cave salamander is relatively restricted. In Indiana it occurs only in the southern half of the state and a more compressed range essentially equal to the karst areas of the Appalachians, Interior Low Plateaus and Ozarks.

Plethodon glutinosus (Green) TX Slimy salamander

Ripley Co.: Bernice Chandler Cave (GC 06)

S5/G5; Although the Slimy salamander is recorded from much of the eastern U.S., Minton (2001) reported that this is actually a complex of species that are essentially morphologically identical. Minton gave the habitat as usually hilly, rocky wooded areas, or woodlands along streams.

Plethodon cinereus (Green) TX Redback salamander

Jefferson Co.: Henry Dilk Falls Cave (BC 08), Henry Dilk Falls Annex Cave, Three Raiders Monument Cave (BC 11), Ollie Wilson Cave (BC 19),

S5/G5; Most of the Indiana records of this species are associated with rocks or leaf litter in forest settings (Minton, 2001).

ORDER SALIENTIA

FAMILY RANIDAE

Rana palustris LeConte TX Pickerel frog

Jefferson Co.: Isaiah Irwin Cave (BC 02); Timber Lodge Spring Cave (GC 03), S5/G5; Minton (2001) reported that in southern Indiana the Pickerel frog was nearly always found near spring streams, often in or near caves. Otherwise, this species occurs across much of the eastern U.S.

Rana utricularia Harlan AC Southern leopard frog

Jefferson Co.: Henry Dilk Falls Cave (BC 08)

S5/G5; The frog cited above was being consumed by a crayfish.

CLASS AVES

ORDER PASSERIFORMES

FAMILY TYRANIDAE

Sayornis phoebe (Latham) TX Eastern phoebe

Jefferson Co.: Henry Dilk Falls Annex Cave, Ollie Wilson Cave (BC 19); Ripley Co.: Louis Neil Cave (GC 02), Asa and Sarah Edwards Cave (OC 01)

S5/G5; The Eastern phoebe constructs nests under overhangs and frequently chooses shelters and cave entrances.

CLASS MAMMALIA

ORDER CHIROPTERA

FAMILY VESPERTILIONIDAE

Eptesicus fuscus (Beauvois) TX Big brown bat

Jefferson Co.: Gray's Cave (MF 01); Ripley Co.: Louis Neil Cave (GC 02)

S5/G5; This bat appears to withstand, perhaps prefer, more cold than most of the other bats that occur in Indiana. Big brown bats typically occur in or near the entrances of caves, where they typically hang singly on the cave walls or wedge themselves into cracks (both horizontal and vertical) (Mumford and Whitaker, 1982).

Myotis septentrionalis TX Northern long-eared bat

Jefferson Co.: Gray's Cave (MF 01)

S5/G5 This is the bat formerly known as Keen's bat, which is now restricted to the Pacific coast area.

Myotis spp. TX

Jefferson Co.: Gray's Cave (MF 01); Ripley Co.: Bernice Chandler Cave (GC 06)

Pipistrellus subflavus (Cuvier) TX Eastern pipistrelle

Jefferson Co.: Gray's Cave (MF 01), Dorman Yeager Cave (BC 07), Henry Dilk Falls Cave (BC 08), Ollie Wilson Cave (BC 19); Ripley Co.: Everett Shonk Cave (GC 05), Bernice Chandler Cave (GC 06)

S5/G5; The Eastern pipistrelle is a common, permanent inhabitant of southern Indiana. Mumford and Whitaker (1982) reported that almost every cave visited contained at least one bat of this species, although only three caves had 50 or more (one of these was Dillon Cave). It was also noted that in small caves the pipistrelle was frequently the only bat species present. These bats always roost singly and usually occur on the walls or overhanging ledges rather than on the ceilings of caves. Pipistrelles occur in caves during all months of the year, although relatively few occur there during the summer months.

ORDER RODENTIA

FAMILY CRICETIDAE

Peromyscus leucopus (Rafinesque) TX White-footed mouse

Jefferson Co.: Gray's Cave (MF 01), Elmer Turner Cave (BC 03), Henry Dilk Falls Cave (BC 08), Bernice Chandler Cave (GC 06)

S5/G5; This species of mouse is one of the most common mammals in Indiana (Mumford and Whitaker, 1982). It frequently enters caves and Banta (1907) recorded it at least 1500 feet from the entrance of Mayfield's Cave in Monroe County. The mice are seldom seen, but their droppings are commonly found in and around pitfall traps, as are the fleas that are their ectoparasites.

ORDER CARNIVORA

FAMILY PROCYONIDAE

Procyon lotor (Linnaeus) TX Raccoon

Jefferson Co.: Mary Spurgin Cave (BC 05), Henry Dilk Falls Cave (BC 08); Ripley Co.: Asa and Sarah Edwards Cave (OC 01)

S5/G5; Evidence of raccoons in caves usually consists of latrines, which are important sources of food for the invertebrate community.

FAMILY CANIDAE

Canis latrans Say TX Coyote

Jefferson Co.: Isaiah Irwin Cave (BC 02)

S5/G5; The shelter entrance of this cave was being used as a den site, as evidenced by the remnants of prey, odor and tracks.

MIDDLEFORK CREEK DRAINAGE

This drainage system is the southern most in BONWR. It is zoogeographically interesting in that it is the only area of the refuge where the isopod Caecidotea stygia occurs, replaced to the north by Caecidotea rotunda. Although only two caves are known along Middlefork Creek, nine obligate subterranean species are known from the drainage. One of the most biologically productive caves in BONWR, Gray's Cave, is present on Middlefork Creek. Eight of the nine species known from the drainage have been found in this cave, including the undescribed species of the springtail insect Arrhopalites (known only from this site). Gray's Cave is also significant for the presence of three species of bats, including Myotis septentrionalis.

The obligate subterranean species known from Middlefork Creek drainage are:
Sphalloplana weingartneri Weingartner's cave flatworm (G2)
Caecidotea stygia Northern cave isopod (G5)
Crangonyx packardi Packard's groundwater amphipod (G3)
Oreonetides undescribed species Undescribed cave sheet-web spider (G1)
Phanetta subterranea Subterranean sheet-web spider (G5)
Sinella alata Indiana cave springtail (G3)
Pseudosinella undescribed species near fonsa (G1)
Arrhopalites undescribed species near pygmaeus (G1)
Spelobia tenebrarum Cave dung fly (G5)

Gray's Cave (Middlefork Creek 01)

Description: This cave is 454 feet in length, which starts out in a walking height passage that quickly turns into a stoopway, then crawlway. Only a single entrance is present and a relatively long dark zone is available for sampling in Gray's Cave. A stream flows the length of the cave with intermittent gravel pools and riffles.

Obligate subterranean species: 8

Sphalloplana weingartneri Weingartner's cave flatworm (G2)
Caecidotea stygia Northern cave isopod (G5)
Crangonyx packardi Packard's groundwater amphipod (G3)
Oreonetides undescribed species Undescribed cave sheet-web spider (G1)
Phanetta subterranea Subterranean sheet-web spider (G5)
Sinella alata Indiana cave springtail (G3)
Arrhopalites undescribed species near pygmaeus (G1)
Spelobia tenebrarum Cave dung fly (G5)

Species of management concern: 5

Sphalloplana weingartneri Weingartner's cave flatworm (G2)
Crangonyx packardi Packard's groundwater amphipod (G3)
Oreonetides undescribed species Undescribed cave sheet-web spider (G1)
Sinella alata Indiana cave springtail (G3)
Arrhopalites undescribed species near pygmaeus (G1)

Vertebrates: 5

Eurycea lucifuga Cave salamander

Pipistrellus subflavus Eastern pipistrelle

Eptesicus fuscus Big brown bat

Myotis septentrionalis Northern long-eared bat

Peromyscus leucopus white-footed mouse

Communities: Unlike many caves at BONWR, Gray's Cave has only one entrance, although the presence of a Big brown bat in a dome near the back of the cave suggests cold air coming in from the surface. The relative stable conditions in the absence of a second entrance makes this cave one of the best habitats for troglobites on the refuge. Datalogger data taken for the period of January – March, 2001 (figure 4) indicate this temperature stability and, if correctly calibrated, a temperature at least six degrees colder than is typical for Indiana caves. In the stream community three species of the amphipod Crangonyx have been found, C. packardi and C. forbesi in the cave and C. setodactylus in the spring. The flatworm Sphalloplana weingartneri was found under a stone in a small infeeder stream. The main stream is also inhabited by the isopod Caecidotea stygia and the crayfish Cambarus laevis.

The riparian fauna of this cave is also outstanding among the refuge's caves. Five species of spiders were found, including two troglobites, the ubiquitous Phanetta subterranea and the rare Oreonetides, known from a single specimen taken from a long stick fairly deep in the dark zone of the cave. The funnel-web spider Calymmaria cavicola was taken at the beginning of the dark zone, while another funnel-web spider Coras lamellosus was taken in the entrance. The cave orb-weaver Meta ovalis was also found in the entrance passage.

Among the insects were the troglobitic springtails Sinella alata and Arrhopalites undescribed species, the latter known only from this site. Entrance area fauna included mosquito Anopheles punctipennis. Deeper in the cave on riparian mudbanks were the flies Megaselia cavernicola and Spelobia tenebrarum. The depigmented rove beetle Aleochara lucifuga was taken from pitfalls in the dark zone of the cave. Wall insect fauna included the over-wintering moth Scoliopteryx libatrix and the fly Aecothea specus.

At least three species of bats occur in the cave, Pipistrellus subflavus, Myotis septentrionalis and Eptesicus fuscus. Another unidentified Myotis that could not be adequately examined in a crack poses the possibility of a fourth species. The presence of several bat species in this cave suggests that the lower temperature indicated by the dataloggers may in fact be correct. Other vertebrates present in the cave were the Cave salamander Eurycea lucifuga and White-footed mice Peromyscus leucopus that raided the pitfall trap baits.

Figure 4. Datalogger temperature data, Gray's Cave.

Kathryn Bayless Cave (Middlefork Creek 02)

Description: This cave is 27 feet in length. A stream flows from a low, unenterable passage into the shelter-like cave and then emerges as a spring. The dark zone can not be penetrated in this cave, but the entrance is walled lending some stability to the available habitat.

Obligate subterranean species: 5

Sphalloplana weingartneri Weingartner's cave flatworm (G2)

Caecidotea sp. cave isopod

Sinella alata Indiana cave springtail (G3)

Pseudosinella undescribed species near fonsa (G1)

Spelobia tenebrarum Cave dung fly (G5)

Species of management concern: 5

Sphalloplana weingartneri Weingartner's cave flatworm (G2)

Sinella alata Indiana cave springtail (G3)

Pseudosinella undescribed species near fonsa (G1)

Vertebrates: 4

Eurycea lucifuga Cave salamander

Desmognathus fuscus Dusky salamander

Sayornis phoebe Eastern phoebe

Procyon lotor Raccoon

Communities: Due to the enclosed nature of the entrance, this cave has a mixture of cave stream, riparian, entrance and spring communities. All of the terrestrial troglobites noted above were taken from raccoon droppings, as well as the troglomorphic ground beetle Platynus tenuicollis. The isopod Caecidotea sp. present at this site remains unidentified lacking a male specimen. Caecidotea rotunda occurs nearby in a spring on the south side of the creek, while Caecidotea stygia occurs downstream in Gray's Cave. Other stream inhabitants found were the amphipod Crangonyx forbesi, crayfish Cambarus laevis, flatworms Phagocata gracilis and the stygobite Sphalloplana weingartneri and the Dusky salamander Desmognathus fuscus. Other vertebrates are noted above. The phoebe had an active nest with eggs present at this site.

Spring across Middlefork Creek from MF02

Description: This is a small spring that issues from the base of the hill on the other side of the creek from the cave MF02, near an old homesite. No distinct orifice is present and the flow may be seasonal.

Obligate subterranean species: 1

Caecidotea rotunda Southeastern Indiana cave isopod (G2)

Species of management concern: 1

Caecidotea rotunda Southeastern Indiana cave isopod (G2)

Vertebrates: 0

Communities: This spring may dry up during low flow accounting for the low numbers and low diversity present. The isopod Caecidotea rotunda was found under the leaves in the origin of the spring, as well as the flatworm Phagocata gracilis and the amphipod Crangonyx forbesi.

Well, Middlefork Creek drainage, Section 30 NW 1/4

Description: This is an open three foot diameter stone-line well with no cap

Obligate subterranean species: 0

Species of management concern: 0

Vertebrates: 0

Communities: No fauna was obtained from this well on the first and second baitings. Due to its proximity to an old landfill the well was baited a third time. An undetermined epigeal flatworm was the only fauna obtained.

BIG CREEK DRAINAGE

With 19 reported caves, over half of those reported at BONWR occur along the Big Creek drainage. None are outstanding by themselves, but as an assemblage when combined with the wells sampled the Big Creek drainage was found to be inhabited by 12 species of obligate subterranean animals. This creek is the next drainage to the north of Middlefork Creek and is zoogeographically distinctive in the presence of the rare subterranean isopod Caecidotea rotunda, which has the southern end of its range along Big Creek, with a single locality known on Middlefork Creek. The undescribed species of the springtail insect Arrhopalites and the undescribed species of the copepod crustacean Diacyclops undescribed species (near yeatmani) are known globally from individual caves on this drainage.

The obligate subterranean species known from the Big Creek drainage are:

Candona sp. s. latu, groundwater ostracod (G1)

Diacyclops undescribed species B Undescribed groundwater copepod (G1)

Diacyclops undescribed species C Undescribed groundwater copepod (G1)

Crangonyx packardi Packard's groundwater amphipod (G3)

Crangonyx undescribed species Lewis' cave amphipod (G2)

Caecidotea rotunda Southeastern Indiana groundwater isopod

Phanetta subterranea Subterranean sheet-web spider (G5)

Hesperochernes mirabilis Wonderful pseudoscorpion (G3)

Sinella cavernarum Indiana cave springtail (G3)

Pseudosinella fonsa Fountain cave springtail G2

Arrhopalites undescribed species near caedus (G1)

Spelobia tenebrarum Cave dung fly (G5)

Charles Bear Cave (Big Creek 01)

Description: This cave is 249 feet in length, the passage connecting two entrances on Big Creek with a sinkhole entrance to the north. A stream flows the length of the cave, which generally ranges from 1 ½ to 3 feet in height. Quantities of broken glass, crockery and rusty wire occur in the streambed.

Obligate subterranean species: 2

Caecidotea rotunda Southeastern Indiana groundwater isopod (G2)

Crangonyx packardi Packard's groundwater amphipod (G3)

Species of management concern: 2

Caecidotea rotunda Southeastern Indiana groundwater isopod (G2)

Crangonyx packardi Packard's groundwater amphipod (G3)

Vertebrates: 1

Unspecified bats, probably Pipistrellus subflavus Eastern pipistrelle (Sheldon, 1997)

Communities: Cave stream and riparian habitats are present in this cave. Obligate subterranean species noted above in the stream indicate that it probably represents groundwater rather than surface runoff. Other aquatic species present was the spring isopod Lirceus fontinalis. The terrestrial fauna included the over-wintering moth Scoliopteryx libatrix and mosquitos Anopheles punctipennis. In the riparian habitat were found the troglophilic milliped Cambala minor, terrestrial isopod Trachelipus rathkei, a funnel-web spider Wadotes sp. and the pirate wolf spider Pirata sedentarius. Other wall and ceiling fauna included the cave orb weaver Meta ovalis and crickets Ceuthophilus stygius.

Isaiah Irwin Cave (Big Creek 02)

Description: This cave is 229 feet in length, a tunnel-like passage averaging 3 feet in height that connect the spring entrance on Big Creek with a sinkhole entrance to the north. A stream flows the length of the cave, primarily over a scoured limestone substrate.

Obligate subterranean species: 0

Species of management concern: 0

Vertebrates: 3

Unspecified salamanders, probably Eurycea lucifuga Cave salamander (Sheldon, 1997)

Rana palustris Pickerel frog

Canis latrans Coyote

Communities: Cave stream and riparian habitats are available for community assembly in this cave, but the water flowing through the cave appears to be mostly or entirely of a surface origin and the stream lacks stygobiontic species. Aquatic species present were the flatworm Phagocata gracilis, isopod Lirceus fontinalis, amphipod Crangonyx setodactylus and crayfish Cambarus laevis. The cave has been stream scoured and a significant wind blows through it making the entire cave relatively low in humidity. This is probably one of the least inhabitable caves for obligate subterranean species in BONWR. Terrestrial species were sparse, but found were the fishing spider Dolomedes scriptus, orb weaver Meta ovalis, cave cricket Ceuthophilus stygius, and overwintering Herald moths Scoliopteryx libatrix and mosquitos Anopheles punctipennis. Pickerel frogs were found near the spring entrance in and next to the cave stream.

The shelter entrance on Big Creek appears to be used by Coyotes as a den. Evidence for this is the smell of urine, the presence of intact vertebral columns and other bones of prey left in the cave as well as Coyote tracks in the sand nearby.

Elmer Turner Cave (Big Creek 03)

Description: This cave is 255 feet in length. Two entrances allow access from Big Creek. A few pools occur in the rear of the cave but no stream was present.

Obligate subterranean species: 3

Phanetta subterranea Subterranean sheetweb spider (G5)

Hesperochernes mirabilis Wonderful pseudoscorpion (G3)

Spelobia tenebrarum Cave dung fly (G5)

Species of management concern: 1

Hesperochernes mirabilis Wonderful pseudoscorpion (G3)

Vertebrates: 2

Unidentified bat

Peromyscus leucopus White footed mouse

Communities: The water in this cave appears to be temporary in nature and the only species found in it were sparse amphipods Crangonyx setodactylus and one of the crayfish Cambarus laevis. Any other aquatic invertebrates present might well have been consumed by the crayfish. The terrestrial community included the spider Phanetta subterranea, pseudoscorpion Hesperochernes mirabilis, springtails Arrhopalites pygmaeus, Isotoma undescribed species, staphylinid beetle Lesteva pallipes, leiodid beetle Catops gratusus, rove beetle Atheta troglaphila and flies Megaselia cavernicola, Spelobia tenebrarum.

An unidentified bat was noted flying in the passage on one visit and on a subsequent trip moth wing clippings were noted on the passage floor. Pitfall traps had mouse droppings in and around them.

John Sample Cave (Big Creek 04)

Description: This 140 foot cave connects two sinkhole entrances via a tight, winding crevice-like passage. The cave lies directly behind Elmer Turner Cave (BC 02) and is probably a disjunct part of the same system. No water was present during two visits.

Obligate subterranean species: 1
Spelobia tenebrarum Cave dung fly (G5)

Species of management concern: 1
Sminthurides hyogramae springtail (G1)

Vertebrates: 0

Communities: Most of what was found in this short cave came from leaf litter taken near the entrance, which produced collembolans, Sminthurides hyogramae, Isotoma undescribed species, Arrhopalites pygmaeus, Folsomia stella, Folsomia candida, Tomocerus lamelliferus, Hypogastrura sp., millipeds Cambala minor and Cleidogona sp., a pseudoscorpion Apochthonius sp., cave orb weaver Meta ovalis, fishing spider Dolomedes scriptus, funnelweb spider Cicurina pallida and cricket Ceuthophilus stygius.

Mary Spurgin Cave (Big Creek 05)

Description: This cave is a low crawlway 53 feet in length. A flowing stream was present during a winter visit, but was nearly dry on a subsequent trip.

Obligate subterranean species: 1
Crangonyx packardi Packard's groundwater amphipod (G3)

Species of management concern: 1
Crangonyx packardi Packard's groundwater amphipod (G3)

Vertebrates: 1
Procyon lotor Raccoon

Communities: A tiny intermittent stream and associated riparian habitat are present in this cave. The lone presence of the amphipod Crangonyx packardi, a species that occurs in many non-cave subterranean habitats, suggests that the stream in this cave is ephemeral and is not permanently inhabited by cavernicolous species. Other fauna in this tiny cave included over-wintering species like the Herald moth Scoliopteryx libatrix and mosquitos Anopheles punctipennis. Under stones near the entrance in riparian habitat were found the spiders Pirata sedentarius and Cicurina pallida, milliped Scytonotus

granulatus, and the terrestrial isopods Haplothalmus danicus, Trachelipus rathkei and Cylisticus convexus. Wall fauna included the orb weaver Meta ovalis and crickets Ceuthophilus stygius. Raccoons visit the cave as evidenced by their droppings.

Grace Bear Sycamore Cave (Big Creek 06)

Description: This 26 foot cave is a mostly collapsed crawlway with a small amount of water emerging.

Obligate subterranean species: 1

Caecidotea rotunda Southeastern Indiana cave isopod (G2)

Species of management concern: 1

Caecidotea rotunda Southeastern Indiana cave isopod (G2)

Vertebrates: 0

Communities: This cave was essentially only a spring inhabited by the isopod Caecidotea rotunda and the flatworm Phagocata gracilis. Inspection of the barely enterable cave passage revealed the spider Meta ovalis, cave cricket Ceuthophilus stygius, overwintering mosquitos Anopheles punctipennis and a terrestrial isopod Trachelipus rathkei.

Dorman Yager Cave (Big Creek 07)

Description: This 436 foot cave consists of a dry crawlway connecting an entrance on Big Creek and another entrance in a sinkhole above the creek. Although the cave takes wet-weather flow, no permanent stream flows in it.

Obligate subterranean species: 2

Pseudosinella fonsa Fountain cave springtail (G2)

Spelobia tenebrarum Cave dung fly G(5)

Species of management concern: 1

Pseudosinella fonsa Fountain cave springtail (G2)

Vertebrates: 1

Pipistrellus subflavus Eastern pipistrelle

Communities: The primary habitat in this cave is non-riparian terrestrial consisting of sand, gravel cobbles and sparse litter. The two troglobites found in the cave noted above, as well as the leiodid beetle Catops gratiosus, rove beetle Aleochara lucifuga and the fly Megaselia cavernicola were drawn to pitfall traps. Leaf litter produced the terrestrial isopod Cylisticus convexus and milliped Petaserpes sp. Wall fauna included the fly Amoebaleria defessa. Overwintering in the cave were the Herald moth Scoliopteryx libatrix and mosquitos Anopheles punctipennis. One Eastern pipistrelle was noted.

Henry Dilk Falls Cave (Big Creek 08)

Description: With 617 feet of passage surveyed, this is the longest cave known in BONWR in the Big Creek drainage. A shallow stream flows the length of the cave over a combination of scoured limestone and gravel bars. The passage averages 3 ½ feet high by 3 feet wide between where the stream cascades as a waterfall from the main entrance on Big Creek and the sinkhole entrance a few hundred feet to the south of the creek.

Obligate subterranean species: 5

Candona sp. s. latu, groundwater ostracod (G1)

Diacyclops undescribed species C Undescribed groundwater copepod (G1)

Crangonyx packardi Packard's groundwater amphipod (G3)

Crangonyx undescribed species Lewis' cave amphipod (G2)

Spelobia tenebrarum Cave dung fly (G5)

Species of management concern: 34

Candona sp. s. latu, groundwater ostracod (G1)

Diacyclops undescribed species C Undescribed groundwater copepod (G1)

Crangonyx packardi Packard's groundwater amphipod (G3)

Crangonyx undescribed species Lewis' cave amphipod (G2)

Vertebrates: 7

Eurycea lucifuga Cave salamander

Eurycea longicauda Longtail salamander

Plethodon dorsalis Zigzag salamander

Rana pipiens Southern leopard frog

Pipistrellus subflavus Eastern pipistrelle

Peromyscus leucopus White-footed mouse

Procyon lotor Raccoon

Communities: This cave is a “tunnel” between two entrances and as such feels the effects of cold air and low humidity in the winter, accounting for the low diversity present in the riparian terrestrial troglobitic community. A single troglobitic species, the fly Spelobia tenebrarum was found in this habitat. Troglophiles present in the riparian zone were the spider Meta ovalis, milliped Cambala minor, springtail Tomocerus flavescens, cave crickets Ceuthophilus stygius and C. meridionalis, rove beetles Atheta trogliphila atheta ventricosa, Lesteva pallipes, ground beetle Platynus tenuicollis, flies Megaselia cavernicola, Heleomyza brachypterna and Macrocera nobilis.

The stream community was richer, with two stygobitic species of the amphipod Crangonyx present as well as a subterranean ostracod Candona species and subterranean copepod Diacyclops undescribed species C. All of these crustaceans were found using the Karaman-Chappuis method for extraction of invertebrates from stream gravels.

Significant diversity was found among the invertebrates inhabiting this cave, with 7 species found. Of these, the Leopard frog was being consumed by a crayfish and may well have been an accidental.

Henry Dilk Falls Annex Cave

Description: This is an unmapped shelter cave adjacent to BC 08. It occurs downstream of the waterfall cave at about head height on the south side of Big Creek.

Obligate subterranean species: 0

Species of management concern: 0

Vertebrates: 2

Plethodon cinereus Redback salamander

Sayornis phoebe Eastern phoebe

Communities: Only entrance zone community exists in this shelter, characterized by the two vertebrates noted above, the milliped Cambala minor and the cliff-dwelling spider Achaearanea tepidariorum.

Shirley and Agnes Harsin Cave (Big Creek 09)

Description: This cave has 237 feet of mapped passage enterable from a spring or adjacent dry entrances on Big Creek. A chunk of breakdown blocked the spring entrance and the dry entrance had been silted in, preventing entry without extensive digging.

Obligate subterranean species: 2

Sinella cavernarum Indiana cave springtail (G3)

Spelobia tenebrarum Cave dung fly (G5)

Species of management concern: 1

Sinella cavernarum Indiana cave springtail (G3)

Vertebrates: 0

Communities: Spring, stream and riparian terrestrial communities are potentially present in this cave but digging would be required to sample them. Common spring dwellers including the flatworm Phagocata gracilis and the isopod Lirceus fontinalis were both present. The small amount of terrestrial habitat surveyed revealed the fly Spelobia tenebrarum and springtail Sinella cavernarum beneath a piece of shrapnel. The cave orb weaver Meta ovalis was also present on the walls.

John and Daisy Smith Cave (Big Creek 10)

Description: This cave has 61 feet cave of unstable, collapsing passage entered via a crawlway on the bluff of Big Creek. A very small stream flows in the cave.

Obligate subterranean species: 1

Caecidotea rotunda Southeastern Indiana cave isopod (G2)

Species of management concern: 1

Caecidotea rotunda Southeastern Indiana cave isopod (G2)

Vertebrates: 0

Communities: This cave consists of a stream in which we found sparse isopods, Caecidotea rotunda, and some rocky riparian habitat in which no troglobites were found despite placement of pitfalls. A diverse rove beetle assemblage was demonstrated in this cave: Aleochara castaneipennis, Atheta annexa, Atheta trogliphila and Tachinus fumipennis. Trogliphiles in the cave included the beetle Catops graciosus, spider Cicurina pallida and fly Megaselia cavernicola. Juvenile springtails Onychiurus sp. and Sminthurides sp. were taken from leaves.

Three Raiders Monument Cave (Big Creek 11)

Description: This cave has 70 feet cave of breakdown strewn passage entered via a spring entrance at the base of the bluff of Big Creek. A very small stream flows in the cave.

Obligate subterranean species: 2

Caecidotea rotunda Southeastern Indiana cave isopod (G2)

Spelobia tenebrarum Cave dung fly (G5)

Species of management concern: 0

Caecidotea rotunda Southeastern Indiana cave isopod (G2)

Vertebrates: 1

Plethodon cinereus Redback salamander

Communities: This cave consists of a stream in which we found sparse stygobitic isopods, Caecidotea rotunda, as well as the spring inhabitant Lirceus fontinalis. Other species found in the stream were the amphipod Synurella dentata, the crayfish Cambarus laevis, and unidentified salamander larvae (possibly Desmognathus). In the rocky riparian habitat was found the troglitic fly Spelobia tenebrarum. Trogliphiles in the cave included the beetle Catops graciosus, milliped Cambala minor, terrestrial isopod Haplothalmus danicus, and rove beetle Lesteva pallipes, fly Megaselia cavernicola. The salamander Plethodon cinereus was also present as a threshold troglaxene.

Benjamin Conway Quarry Cave (Big Creek 12)

Description: This cave consists of 231 feet cave of body-sized tubular stream passage entered via a spring at the base of a quarry wall on Big Creek. A small stream flows in the cave.

Obligate subterranean species: 0

Species of management concern: 0

Vertebrates: 0

Communities: This cave consists of scoured streambed and scoured riparian cave walls. A pitfall placed just inside the entrance was destroyed, probably by raccoons. The spring isopod Lirceus fontinalis and spring amphipod Crangonyx forbesi were found in the stream.

Roscoe Wilson Cave (Big Creek 13)

Description: This is a talus cave created by the collapse of a shelter cave to form a void underneath the broken down slabs of limestone. The cave consists of 59 feet of dry, leaf strewn passage.

Obligate subterranean species: 1

Hesperoernes mirabilis Eastern cave pseudoscorpion (G3)

Species of management concern: 1

Hesperoernes mirabilis Eastern cave pseudoscorpion (G3)

Vertebrates: 0

Communities: The fauna of this cave was mostly associated with leaf litter, including the pseudoscorpion Hesperoernes mirabilis, pirate wolf spider Pirata sedentarius, terrestrial isopods Cylisticus convexus, Haplothalmus danicus, three species of epigean springtails Hypogastrura sp., Isotoma notabilis and Onychiurus sp., rove beetle Lesteva pallipes and the leiodid beetle Catops gratiosus.

Martha Beard Fern Cave (Big Creek 14)

Description: This is a crawlway spring cave with of 59 feet of passage.

Obligate subterranean species: 2

Phanetta subterranea Subterranean sheet-web spider (G5)

Spelobia tenebrarum Cave dung fly (G5)

Species of management concern: 0

Vertebrates: 1

Desmognathus fuscus Northern dusky salamander

Communities: This cave is so tight that little habitat is available for sampling other than the stream. The common spring inhabitants, flatworm Phagocata gracilis, isopod Lirceus fontinalis and Dusky salamander Desmognathus fuscus were present. Sampling in the cave at the limit of penetration revealed the presence of the two terrestrial troglobites noted above, as well as the rove beetle Lesteva pallipes.

Edward Prenatt Cave (Big Creek 15)

Description: This cave has 239 feet of passage connecting a sinkhole entrance to the main entrance on Big Creek. The passage floor is littered with broken glass and wire.

Obligate subterranean species: 1

Caecidotea rotunda Southeastern Indiana cave isopod (G2)

Species of management concern: 1

Caecidotea rotunda Southeastern Indiana cave isopod (G2)

Vertebrates: 2

Eurycea lucifuga Cave salamander

Notropis sp. shiner (Bass minnows of Sheldon, 1997)

Communities: This cave exhibited stream fauna that was a mixture of a subterranean species Caecidotea rotunda, spring or troglomorphic species like the isopod Lirceus fontinalis, amphipod Crangonyx setodactylus, crayfish Cambarus laevis and accidentals like the minnows seen by Sheldon (one was glimpsed before disappearing into muddy water while sampling) and water striders Gerris sp. In the riparian habitat were found spiders Pirata sedentarius, Meta ovalis, Cicurina pallida, terrestrial isopod Ligidium elrodi, and cave crickets Ceuthophilus stygius.

Hunter Jines Cave (Big Creek 16)

Description: This is a small spring cave with 31 feet of passage.

Obligate subterranean species: 1

Crangonyx packardii Packard's groundwater amphipod (G3)

Species of management concern: 1

Crangonyx packardi Packard's groundwater amphipod (G3)

Vertebrates: 2

Desmognathus fuscus Dusky salamander

Procyon lotor Raccoon

Communities: The stream community in this cave consisted of the amphipod Crangonyx packardi, the flatworm Phagocata gracilis, crayfish Cambarus laevis, and salamander Desmognathus fuscus. The cave was cold and sparsely inhabited otherwise. Raccoon dung held the beetle Catops gratusus. The only other invertebrate noted was the rove beetle Lesteva pallipes.

Glen and Florence Shoots Cave (Big Creek 17)

Description: This is a small spring cave with 52 feet of passage connecting two entrances.

Obligate subterranean species: 2

Caecidotea rotunda Southeastern Indiana cave isopod (G2)

Crangonyx packardi Packard's groundwater amphipod (G3)

Species of management concern: 2

Caecidotea rotunda Southeastern Indiana cave isopod (G2)

Crangonyx packardi Packard's groundwater amphipod (G3)

Vertebrates: 0

Communities: In some ways this cave is more like a natural bridge, with two entrances separated by a short distance. The stream community in this cave consisted of the amphipod Crangonyx packardi, isopod Caecidotea rotunda and the flatworm Phagocata gracilis. Sheldon (1997) noted the presence of large crickets Ceuthophilus stygius.

Sadie and Juanita Jines Cave (Big Creek 18)

Description: This is a small spring cave is 26 feet long.

Obligate subterranean species: 2

Caecidotea rotunda Southeastern Indiana cave isopod (G2)

Crangonyx packardi Packard's groundwater amphipod (G3)

Species of management concern: 2

Caecidotea rotunda Southeastern Indiana cave isopod (G2)

Crangonyx packardi Packard's groundwater amphipod (G3)

Vertebrates: 0

Communities: Cave stream fauna included the spring flatworm Phagocata gracilis and the two stygobitic species listed above. The only terrestrial fauna noted were the orb weaver Meta ovalis and the overwintering Herald moth Scoliopteryx libatrix.

Sadie and Juanita Jines Karst Window

Description: This is a small karst window behind Sadie and Juanita Jines Cave. The stream flows from an impenetrable crack and disappears into the breakdown, then presumably flows the short distance to emerge from the cave entrance.

Obligate subterranean species: 1

Caecidotea rotunda Southeastern Indiana cave isopod (G2)

Species of management concern: 1

Caecidotea rotunda Southeastern Indiana cave isopod (G2)

Vertebrates: 0

Communities: The isopod noted above was found on pieces of rock in the stream.

Ollie Wilson Cave (Big Creek 19)

Description: This small spring cave is 27 feet long.

Obligate subterranean species: 3

Caecidotea rotunda Southeastern Indiana cave isopod (G2)

Arrhopalites undescribed species near caedus (G1)

Spelobia tenebrarum Cave dung fly (G5)

Species of management concern: 1

Caecidotea rotunda Southeastern Indiana cave isopod (G2)

Arrhopalites undescribed species near caedus (G1)

Vertebrates: 4

Eurycea longicauda Longtail salamander

Plethodon cinereus Redback salamander

Sayornis phoebe Eastern phoebe

Pipistrellus subflavus Eastern pipistrelle

Communities: The only aquatic species associated with this cave were the isopods Lirceus fontinalis and sparse Caecidotea rotunda. The terrestrial fauna included the undescribed species of springtail Arrhopalites and Hypogastrura, spiders Cicurina pallida, Meta ovalis, rove beetle Lesteva pallipes, ground beetle Platynus tenuicollis, and flies

Spelobia tenebrarum and Megaselia cavernicola. The salamander Plethodon cinereus was found under a rock in the entrance and Eurycea longicauda was found in the twilight zone. The presence of phoebes was indicated by an uninhabited nest.

Well Karst Window

Description: This site consists of a well near Big Creek that is about 10 feet deep. Descending to the bottom reveals a cave stream emerging from a vertical crack, flowing across the bottom of the karst window and disappearing into a somewhat bigger, but still unenterable vertical crack downstream.

Obligate subterranean species: 2

Phanetta subterranea Subterranean sheet-web spider (G5)

Spelobia tenebrarum Cave dung fly (G5)

Species of management concern: 0

Vertebrates: 0

Communities: The only stream inhabitant found was the isopod Lirceus fontinalis and some Chaoborus fly larvae. Soil and rocks slumped into the well produced the two terrestrial troglobites listed above.

Well, Big Creek Drainage, Section 7 NE 1/4

Description: This well lies in the northeast quarter of section 7. It is identified by a concrete base with a steel cap and a 16 inch diameter access hole. The well is a total of 11 feet in depth and contains water to a depth of 8 feet.

Obligate subterranean species: 1

Diacyclops undescribed species B Undescribed groundwater copepod (G1)

Species of management concern: 1

Diacyclops undescribed species B Undescribed groundwater copepod (G1)

Vertebrates: 0

Communities: The well was baited with a shrimp jar on February 3-4, 2001 and produced the amphipod Crangonyx setodactylus, and the copepods Diacyclops undescribed species B and Acanthacyclops venustoides.

Well, Big Creek Drainage, on Section Line 7-8

Description: This well lies on the line between sections 7 and 8. It is identified by a concrete base with a 2 foot access hole. The well is a total of 11 feet in depth and contains water to a depth of 10 feet.

Obligate subterranean species: 0

Species of management concern: 0

Vertebrates: 0

Communities: The well was baited with a shrimp jar on February 3-4, 2001 and produced the amphipod Crangonyx setodactylus.

LITTLE GRAHAM CREEK DRAINAGE

Three small caves are known along the Little Graham Creek drainage in BONWR. Only one subterranean species, the isopod Caecidotea rotunda, has been reported from the caves of this basin.

Mary Kirk Cave (Little Graham Creek 01)

Description: This cave consists of 32 feet of dry passage in the creek bluff.

Obligate subterranean species: 0

Species of management concern: 0

Vertebrates: 1

Eurycea longicauda Longtail salamander

Communities: This dry little cave has little potential for significant inhabitation. Invertebrates noted were the terrestrial isopod Cylisticus convexus, millipede Cambala minor and ground beetle Atranus pubescens. The salamander Eurycea longicauda was a juvenile found under a stone at the entrance and may be the same species. Notes in Sheldon (1997) indicated the presence of spiders (usually Meta ovalis), but none were noted on our visit.

Thomas and Effie Jessie Cave (Little Graham Creek 02)

Description: This cave is a 74 foot passage that averages about three feet in height and connects two entrances. Residual pools were present.

Obligate subterranean species: 1

Caecidotea rotunda Southeastern Indiana groundwater isopod (G2)

Species of management concern: 1

Caecidotea rotunda Southeastern Indiana groundwater isopod (G2)

Vertebrates: 1

Eurycea lucifuga Cave salamander

Communities: This cave was rather desiccated when visited, inhabited only by isopods in residual pools and a couple of cave crickets Ceuthophilus stygius nestled in ceiling cracks. The Cave salamander was reported in mapping survey notes.

Lowell Cooper Cave (Little Graham Creek 03)

Description: This consists of 29 feet of low crawlway passage with a spring emerging from the cave.

Obligate subterranean species: 1

Caecidotea rotunda Southeastern Indiana groundwater isopod (G2)

Species of management concern: 1

Caecidotea rotunda Southeastern Indiana groundwater isopod (G2)

Vertebrates: 0

Communities: This cave consisted of a water-filled tube with the isopod Caecidotea rotunda occurring under stones in the twilight zone.

GRAHAM CREEK DRAINAGE

Seven caves are reported from the Graham Creek drainage in BONWR, including the longest cave in the refuge, Bernice Chandler Cave (over 1500 feet in length). Along with Gray's Cave in Middlefork Creek drainage, Bernice Chandler is one of the most biologically productive caves in BONWR – each has eight known obligate subterranean species recorded. Eleven obligate subterranean species are known from the caves and wells in the Graham Creek drainage:

Sphalloplana weingartneri Weingartner's cave flatworm (G2)

Diacyclops undescribed species B Undescribed groundwater copepod (G1)

Crangonyx undescribed species Lewis' cave amphipod (G2)

Crangonyx packardi Packard's groundwater amphipod (G3)

Caecidotea rotunda Southeastern Indiana groundwater isopod (G2)

Phanetta subterranea Subterranean sheet-web spider (G5)

Oreonetides undescribed species Undescribed cave sheet-web spider (G1)

Sinella alata Indiana cave springtail (G3)

Pseudosinella undescribed species near fonsa (G1)

Onychiurus undescribed species near casus (G1)

Spelobia tenebrarum Cave dung-fly (G5)

Elizabeth Stout Cave (Graham Creek 01)

Description: This is a 197 foot long crawlway passage that averages about 3 feet in height. Although a spring house ruin is present near the entrance, only pools of water were present in the cave.

Obligate subterranean species: 1

Crangonyx packardi Packard's groundwater amphipod (G3)

Species of management concern: 1

Crangonyx packardi Packard's groundwater amphipod (G3)

Vertebrates: 0

Communities: This cave was cold on the day visited and the animals present were a mixture of aquatic pool fauna like the amphipod Crangonyx packardi, entrance zone fauna Meta ovalis, Ceuthophilus stygius and overwintering species like the mosquito Anopheles punctipennis and Herald moth Scoliopteryx libatrix.

Louis Neill Cave (Graham Creek 02)

Description: This cave is 266 feet in length, with much of that length consisting of cold, airy passage connecting the scenic main entrance and two sinkhole entrances. A stream flows the length of the cave.

Obligate subterranean species: 6

Caecidotea rotunda Southeastern Indiana groundwater isopod (G2)

Crangonyx packardi Packard's groundwater amphipod (G3)

Oreonetides undescribed species Undescribed cave sheet-web spider (G1)

Phanetta subterranea Subterranean sheet-web spider (G5)

Sinella alata Indiana cave springtail (G3)

Spelobia tenebrarum Cave dung fly (G5)

Species of management concern: 1

Caecidotea rotunda Southeastern Indiana groundwater isopod (G2)

Crangonyx packardi Packard's groundwater amphipod (G3)

Oreonetides undescribed species Undescribed cave sheet-web spider (G1)

Sinella alata Indiana cave springtail (G3)

Vertebrates: 6

Desmognathus fuscus Dusky salamander

Eurycea lucifuga Cave salamander

Eurycea longicauda Longtail salamander

Sayornis phoebe Eastern phoebe

Eptesicus fuscus Big brown bat

Peromyscus leucopus White-footed mouse

Communities: Much of the cave consists of entrance or spring-like community due to the proximity of three entrances arranged in a linear fashion. The aquatic fauna was a mixture of spring species like the flatworm Phagocata gracilis, isopod Lirceus fontinalis, and amphipods Crangonyx forbesi and Crangonyx setodactylus. Upstream from the spring were found the stygobiont isopod Caecidotea rotunda and the amphipod Crangonyx packardi. The troglophilic crayfish Cambarus laevis was also present in the stream.

The part of the cave between the three entrances was filled with dry leaves with a variety of accidental (non-cave) invertebrates present. Pitfalls beyond the last entrance produced the terrestrial troglobites found in the cave: the springtail Sinella alata and the fly Spelobia tenebrarum. The troglobitic spider Phanetta was found under stones and in the company of another troglobitic spider Oreonetides present in leaf litter coming in from a dome near the back of the cave. Other species present in the riparian habitat were the rove beetle Lesteva pallipes, flies Megaselia cavernicola, Aecothea specus, and the cave cricket Ceuthophilus stygius.

All of the salamanders were found in or near the stream. The presence of phoebes was noted by an old nest. Many mouse droppings were in and around the pitfalls.

Old Timbers Spring Cave (Graham Creek 03)

Description: This cave has 27 feet of passage that once supplied water to a spring house in front of the cave, presumably for use in the Old Timbers Lodge. The entrance has been walled and a steel, hinged door is present.

Obligate subterranean species: 5

Sphalloplana weingartneri Weingartner's cave flatworm (G2)
Crangonyx packardi Packard's groundwater amphipod (G3)
Caecidotea rotunda Southeastern Indiana groundwater isopod (G2)
Phanetta subterranea Subterranean sheet-web spider (G5)
Spelobia tenebrarum Cave dung-fly (G5)

Species of management concern: 1

Sphalloplana weingartneri Weingartner's cave flatworm (G2)
Crangonyx packardi Packard's groundwater amphipod (G3)
Caecidotea rotunda Southeastern Indiana groundwater isopod (G2)

Vertebrates: 1

Rana palustris Pickerel frog
Eurycea lucifuga Cave salamander

Communities: This cave presents habitats for cave stream and riparian communities. The aquatic troglobites cited above were all found in the small stream. Riparian

community troglobites included the two species cited above as well as the fly Megaselia cavernicola and the rove beetle Lesteva pallipes.

The bones of a bat found inside the steel door suggest that a bat was trapped in the cave by closure of the door. The Pickerel frog was found sitting in the door threshold, while the cave salamander was in riparian mudbank habitat.

Heron Hole Cave (Graham Creek 04)

Description: This is a 26 foot long, dry hole in the bluff overlooking Graham Creek

Obligate subterranean species: 0

Species of management concern: 0

Vertebrates: 0

Communities: The fauna demonstrated in this cave was a mixture of non-riparian entrance zone fauna and other forest inhabitants drawn to pitfalls from outside the cave. The cave cricket Ceuthophilus stygius, staphylinid beetle Lesteva pallipes and overwintering mosquito Anopheles punctipennis were all typical troglonexenes of small caves. Also found in the pitfalls were a variety of non-cavernicolous flies, ants, etc. that were not consistent with cave inhabitation, presumably drawn into the short cave by the bait.

Everett Shonk Cave (Graham Creek 05)

Description: This cave consists of one small room with a spring emerging from the entrance. There are 29 feet of passage in the cave.

Obligate subterranean species: 0

Species of management concern: 0

Vertebrates: 1

Pipistrellus subflavus Eastern pipistrelle

Communities: This cave is very short and was cold when examined. The only non-aquatic fauna noted was the above cited bat. No stygobiontic fauna was found in the stream, only the spring inhabitants, the flatworm Phagocata gracilis and isopod Lirceus fontinalis and the amphipod Gammarus minus.

Shonk Farm Cave and Spring (Graham Creek)

Description: This cave consists of one small horizontal room large enough to squeeze into, with a spring emerging from below the entrance. The cave, which is unmapped, is adjacent to Everett Shonk cave.

Obligate subterranean species: 0

Species of management concern: 0

Vertebrates: 0

Communities: No stygobiontic fauna was found in the stream, only the spring inhabitants, the flatworm Phagocata gracilis and isopod Lirceus fontinalis.

Bernice Chandler Cave (Graham Creek 06)

Description: This is the most extensive cave at BONWR, with 1507 feet of passage mapped. The cave has two entrances. The spring entrance on Graham Creek is penetrable for only a short distance due to breakdown in the passage, but airspace exists continuously. The main entrance is in a relatively deep sinkhole and allows entry to both the upstream and downstream sections of the cave. Downstream from the entrance the stream runs along a lower level and a dry upper level is present in places. The largest room in BONWR is present in this passage, associated with a dome and the confluence of the upper and lower passages. Upstream of the entrance the passage bifurcates into two different stream passages not far upstream. Some relatively deep (over a foot) water is present in this section of the cave.

Obligate subterranean species: 8

Sphalloplana weingartneri Weingartner's cave flatworm (G2)
Crangonyx undescribed species Lewis' cave amphipod (G2)
Crangonyx packardi Packard's groundwater amphipod (G3)
Caecidotea rotunda Southeastern Indiana groundwater isopod (G2)
Phanetta subterranea Subterranean sheet-web spider (G5)
Pseudosinella undescribed species near fonsa (G1)
Onychiurus undescribed species near casus (G1)
Spelobia tenebrarum Cave dung-fly (G5)

Species of management concern: 6

Sphalloplana weingartneri Weingartner's cave flatworm (G2)
Crangonyx undescribed species Lewis' cave amphipod (G2)
Crangonyx packardi Packard's groundwater amphipod (G3)
Caecidotea rotunda Southeastern Indiana groundwater isopod (G2)
Pseudosinella undescribed species near fonsa (G1)
Onychiurus undescribed species near casus (G1)

Vertebrates: 5

Eurycea lucifuga Cave salamander
Eurycea longicauda Longtail salamander
Plethodon glutinosus Slimy salamander
Pipistrellus subflavus Eastern pipistrelle

Peromyscus leucopus White-footed mouse

Communities: Bernice Chandler Cave presents a variety of habitat types which account for the rich and significant fauna cited above. Present in this cave are entrance, spring, cave stream and riparian communities. Datalogger data for this cave is presented in figure 5.

The spring is inhabited by significant numbers of the stygobiont isopod Caecidotea rotunda as well as the typical spring dweller Lirceus fontinalis. Also present is the flatworm Phagocata gracilis. On one visit the staphylinid beetle Lesteva pallipes was present in large numbers along the spring as well as deep into the cave.

The richest part of the cave for terrestrial fauna was found between the entrance and the big room, due to the influx of leaf litter from both the entrance sink as well as another spot in which leaf litter is present (probably entering through a sinkhole floor). Part of this area is true riparian habitat while sections of it might be considered upper level non-riparian habitat. Fauna associated with this area were the terrestrial isopods Trachelipus rathkei, Ligidum elrodi, millipeds Scytonotus granulatus, Ophiulus pilosus, spiders Phanetta subterranea, Cicurina pallida, Cybaeus silicis, pseudoscorpion Chthonius sp., springtails Pseudosinella undescribed species, Tomocerus bidentatus, Onychiurus undescribed species, Arrhopalites pygmaeus, Hypogastrura sp., rove beetle Lesteva pallipes, Aleochara lucifuga, Ilyobates puberulus, Atheta troglaphila, beetles Catops graciosus, Platynus tenuicollis, and flies Megaselia cavernicola, Spelobia tenebrarum, Aecothea specus.

Terrestrial fauna was less abundant upstream of the entrance, with leaf litter mostly absent and the primary habitat being riparian mudbanks and moist rock walls. All of the flies, the beetles Aleochara lucifuga, Atheta troglaphila, Catops graciosus, and the spider Cicurina pallida were notably present.

The isopod Caecidotea rotunda is fairly abundant throughout the cave associated with stream gravels and the undersides of rocks. The flatworm Sphalloplana weingartneri is present, but scarce. Of the two amphipods present, Crangonyx packardi is more common, but Crangonyx undescribed species is also present. The largest Cambarus laevis seen at BONWR was found in a deep pool a couple of hundred feet upstream of the entrance to this cave.

The bats found in the cave were mostly downstream of the entrance, with pipistrelles noted not far from the entrance and a Myotis sp. found up in a dome in the big room. Only one Slimy salamander was found and was injured – it was found dead on the next visit. The other salamanders were found in riparian habitat. Mouse droppings were abundant around most of the pitfalls.

Figure 5. Datalogger temperature data, Bernice Chandler Cave.

Alexander Thompson Pit (Graham Creek 07)

Description: This is the only pit known at BONWR and is essentially a fissure that measures 29 feet in depth. The fissure is V-shaped and so tight at the bottom that it is impossible to bend over.

Obligate subterranean species: 0

Species of management concern: 0

Vertebrates: 1

Eurycea lucifuga Cave salamander

Communities: This pit is too tight at the bottom to perform conventional sampling. A PVC pipe baited and lowered to the bottom was covered with flood debris and could not be recovered. A fissure at the top of the pit was inhabited by many cave crickets Ceuthophilus stygius and the above cited salamander.

Spring on Graham Creek below GC 07

Description: This is a small spring found while searching for GC 07.

Obligate subterranean species: 0

Species of management concern: 0

Vertebrates: 0

Communities: The only inhabitant of this spring was Lirceus fontinalis.

Well, Graham Creek drainage, Grapevine Branch, Section 19 NE 1/4

Description: This well is immediately adjacent to Grapevine Branch. It has a 5 foot limestone cap with a 12 inch circular hole. The well is 31 feet in depth, with 22 feet of water.

Obligate subterranean species: 2

Sphalloplana weingartneri Weingartner's cave flatworm (G2)

Crangonyx packardi Packard's groundwater amphipod (G3)

Species of management concern: 2

Sphalloplana weingartneri Weingartner's cave flatworm (G2)

Crangonyx packardi Packard's groundwater amphipod (G3)

Vertebrates: 0

Communities: This well appeared to be very old and is inhabited by significant groundwater fauna as noted, as well as the copepods Acanthocyclops sp. (robustus group) and Orthocyclops modestus.

Well, Graham Creek drainage, NW ¼ Section 18

Description: This well has a round, 4 foot diameter steel reinforced concrete cap. It is 9 feet deep with 7 feet of water.

Obligate subterranean species: 1

Diacyclops undescribed species B Undescribed groundwater copepod (G1)

Species of management concern: 1

Diacyclops undescribed species B Undescribed groundwater copepod (G1)

Vertebrates: 0

Communities: This well was found to be inhabited by the copepods Diacyclops undescribed species B, Attheyella nordenskioldii and the amphipod Crangonyx setodactylus.

Well, Graham Creek drainage, Hungry Hollow, NE ¼ Section 26

Description: This well had a 5 foot diameter limestone cap with a 16 inch diameter central hole. The well was 25 feet deep and contained 18 feet of water.

Obligate subterranean species: 0

Species of management concern: 0

Vertebrates: 0

Communities: The only inhabitant found were epigeal flatworms, Phagocata velata.

OTTER CREEK DRAINAGE

Only one short cave is known from the Otter Creek drainage in BONWR. Four obligate subterranean species are known from this cave as noted below.

Asa and Sarah Edwards Cave (Otter Creek 01)

This is a 27 foot long crawlway spring cave. A dam has been constructed across the stream and walls lead away from the cave.

Obligate subterranean species: 4

Sphalloplana weingartneri Weingartner's cave flatworm (G2)

Caecidotea rotunda Southeastern Indiana cave isopod (G2)

Phanetta subterranea Subterranean sheetweb spider (G5)

Spelobia tenebrarum Cave dung fly (G5)

Species of management concern: 2

Sphalloplana weingartneri Weingartner's cave flatworm (G2)

Caecidotea rotunda Southeastern Indiana cave isopod (G2)

Vertebrates: 2

Sayornis phoebe Eastern phoebe

Procyon lotor Raccoon

Communities: This cave has a combination of spring, cave stream, riparian and dung communities in its short length. The spring is characterized by the presence of the flatworm Phagocata gracilis and isopod Lirceus fontinalis. Inside the entrance of the cave in the stream are found the flatworm Sphalloplana weingartneri and the isopod Caecidotea rotunda. A crayfish Cambarus laevis was found just inside the entrance. Much raccoon dung is found in the cave from which the snail Discus patulus, spider Phanetta subterranea and the fly Spelobia tenebrarum were found. Other invertebrates noted were the orb weaver Meta ovalis and mosquitos Anopheles punctipennis. The presence of phoebes was noted by an old nest under a ledge in the entrance.

Well, Otter Creek drainage, SW ¼ Section 31

Description: This well consists of an open, two foot diameter hole with no cap or other indication, an open water-filled hole in the ground. It is 14 feet deep with 13 ½ feet of water.

Obligate subterranean species: 1

Diacyclops undescribed species B Undescribed groundwater copepod (G1)

Crangonyx anomalous

Species of management concern: 1

Diacyclops undescribed species B Undescribed groundwater copepod (G1)

Crangonyx anomalous

Vertebrates: 0

Communities: This well has a very unusual fauna as noted above.

Well, Otter Creek drainage, Falling Timber Branch, SW ¼ Section 22

Description: This well has a 4 foot concrete cap with a 6 X 18 inch hole. It was 18 feet deep with 16 feet of water

Obligate subterranean species: 0

Species of management concern: 0

Vertebrates: 0

Communities: The only species found at this site was the amphipod Crangonyx setodactylus.

Well, Otter Creek drainage, Falling Timber Branch, SW ¼ Section 22

Description: This well is adjacent to an old concrete horse trough. The well has a 5 foot concrete cap with a 1 foot central hole. The well is 15 feet deep with 14 feet of water in it.

Obligate subterranean species: 0

Species of management concern: 0

Vertebrates: 0

Communities: The only species found at this site was the amphipod Crangonyx setodactylus.

Well, Otter Creek drainage, Little Otter Branch, NW ¼ Section 22

Description: This well has a 4 foot wide limestone cap with an 18 inch square hole. The well is 17 feet deep and had 16 feet of water in it.

Obligate subterranean species: 0

Species of management concern: 0

Vertebrates: 0

Communities: The only species found at this site was the amphipod Crangonyx setodactylus.

Cistern Otter Creek drainage, Little Otter Branch, NW ¼ Section 22

Description: This site appeared to be a concrete cistern rather than a well. It was 6 X 15 feet long with two 18 inch square access holes.

Obligate subterranean species: 0

Species of management concern: 0

Vertebrates: 0

Communities: No fauna was recovered from this cistern.

Well, Otter Creek drainage, Little Otter Branch, NW ¼ Section 22

Description: This well had a roughly trapezoidal limestone cap with a 6 X 18 inch hole. The well was 23 feet deep and contained 12 feet of water.

Obligate subterranean species: 0

Species of management concern: 0

Vertebrates: 0

Communities: The only species found at this site was the amphipod Crangonyx setodactylus.

RESULTS

Sampling in caves and wells at Big Oaks National Wildlife Refuge produced a total of 83 species, of which 68 were invertebrates and 15 vertebrates. These 83 species can be divided into the following ecological categories:

Stygobites	9 species
Stygophiles	6 species
Stygoxenes	5 species
Troglobites	11 species
Troglophiles	23 species
Trogloxenes	48 species
Accidentals	2 species
Total:	83 species

Twenty species believed to be obligate subterranean organisms were discovered at Big Oaks:

Sphalloplana weingartneri Weingartner's cave flatworm (G2)
Diacyclops undescribed species A (G1)
Diacyclops undescribed species B (G1)
Diacyclops undescribed species C (G1)
Candona sp.
Caecidotea rotunda Southeastern Indiana cave isopod (G2)
Caecidotea stygia Northern cave isopod (G5)
Crangonyx packardi Packard's groundwater amphipod (G3)
Crangonyx undescribed species Lewis' cave amphipod (G2)
Oreonetides undescribed species Undescribed cave sheet-web spider (G1)
Phanetta subterranea Subterranean sheet-web spider (G5)
Hesperochernes mirabilis Eastern cave pseudoscorpion (G3)
Sinella alata Indiana cave springtail (G3)
Sinella cavernarum Cavernicolus springtail (G3)
Pseudosinella fonsa Fountain cave springtail (G2)
Pseudosinella undescribed species near fonsa (G1)
Onychiurus undescribed species near casus (G1)
Arrhopalites undescribed species near pygmaeus (G1)
Arrhopalites undescribed species near caedus (G1)
Spelobia tenebrarum Cave dung fly (G5)

A total of 22 species of significant global rarity (G1-G3) were found, including 11 G1 species, 5 G2 species and 6 G3 species:

Diacyclops undescribed species A (G1)
Diacyclops undescribed species B (G1)
Diacyclops undescribed species C (G1)
Candona sp. (G1)

Oreonetides undescribed species Undescribed cave sheet-web spider (G1)
Pseudosinella undescribed species near fonsa (G1)
Onychiurus undescribed species near casus (G1)
Onychiurus undescribed species near parvicornis (G1)
Arrhopalites undescribed species near pygmaeus (G1)
Arrhopalites undescribed species near caedus (G1)
Smithurides hyogrammae springtail (G1)

Sphalloplana weingartneri Weingartner's cave flatworm (G2)
Caecidotea rotunda Southeastern Indiana cave isopod (G2)
Crangonyx undescribed species Lewis' cave amphipod (G2)
Pseudosinella fonsa Fountain cave springtail (G2)
Ilyobates puberulus rove beetle (G2)

Crangonyx packardi Packard's groundwater amphipod (G3)
Crangonyx anomalous Anomalous amphipod (G3)
Hesperochernes mirabilis Eastern cave pseudoscorpion (G3)
Sinella alata Indiana cave springtail (G3)
Sinella cavernarum Cavernicolus springtail (G3)
Tomocerus bidentatus Two-toothed springtail (G3)

DISCUSSION

Evolution and zoogeography of the fauna--The evolution of the cave fauna present in caves of the southeastern Indiana karst was discussed by Lewis (1983). The age of the troglobitic fauna in the area can be estimated with some accuracy due to geologic events. During the Illinoian Glaciation of about 100,000 years ago the ancestors of today's troglobitic fauna are thought to have been present on the surface during the cool, moist conditions of the glacial front. During the Sangamon Interglacial the unglaciated caves of the southcentral Indiana karst were available for colonization and were probably entered by fauna pre-adapted for subterranean life. However, the BONWR was completely covered by till of Illinoian age and caves there were unavailable for colonization. During the subsequent Wisconsin Glaciation conditions again were favorable for cavernicolous animals on the surface. Evidence indicates that the ancestral troglobites emigrated into southeastern Indiana during this time and then colonized caves during the Recent Interglacial as conditions became dryer and warmer with the retreat of the Wisconsin Glacier.

In caves of the southcentral Indiana karst, e.g. in the Blue River drainage (Lewis, 1998), a site exhibiting the habitat diversity typical of a medium size stream will potentially have about 15 niches to be filled (table 1). Habitats necessary for the presence of these animals include stream pools (Amblyopsis, Antroselates, Orconectes), riffles with significant uncemented gravel interstices (Caecidotea, Sphalloplana, Crangonyx), drip pools (Diacyclops, Pseudocandona), riparian terrestrial mudbanks (Pseudanophthalmus, Phanetta, Pseudotremia, Litocampa), and perhaps leaf litter (Sinella, Arrhopalites), or dung (Spelobia). All of these habitats are represented in one or more caves at BONWR, but about half of the available niches either remain unfilled or filled by non-troglobites.

For reasons that are not understood, some of the animal groups found in caves of the southcentral karst are absent in the southeastern karst. Prime examples are the cavefish Amblyopsis and the cave crayfish Orconectes. No fish are regularly present in caves of BONWR that fill the cavefish niche. The cave crayfish niche is occupied by the troglophile Cambarus laevis in caves of BONWR.

Some groups found in the southcentral karst are present in part of the southeastern karst, but have not dispersed to the north as far as BONWR. In the southcentral karst the millipeds of the genus Pseudotremia are present in caves in Harrison, Crawford, Washington and Orange counties, but have not penetrated to the north to Lawrence, Monroe or Owen counties (where they are replaced by Conotyla). Similarly, in the southeastern karst Pseudotremia is present only in Clark County. No troglobitic millipeds have been found in Jefferson, Jennings, Ripley or Decatur counties, with the exception of Trichopetalum unicum, which is probably edaphic rather than troglobitic.

The cave beetles of the genus Pseudanophthalmus have dispersed into Clark, Jefferson and Jennings counties and one record from the tunnel in Clifty Falls State Park is only a couple of miles south of BONWR. Despite repeated searching and placement of

pitfalls in suitable habitat, these beetles have not been found in BONWR nor in the adjacent Crosley State Fish & Wildlife Area. These areas are apparently beyond the ability of Pseudanophthalmus to disperse into during the Wisconsin glaciation. These areas are quite close to the Wisconsin glacial maximum extent and it is entirely possible that the caves were not even available for colonization at that time.

Examination of the obligate subterranean fauna present in the caves and wells at BONWR reveals two kinds of animals. The first group, like the amphipod Crangonyx packardi, spider Phanetta subterranea or fly Spelobia tenebrarum, consists of animals that are widespread in Indiana caves. The amphipod has demonstrated its ability to travel through non-cave saturated interstices and might turn up in any groundwater habitat in its range. Phanetta and Spelobia, although restricted to caves, are only mildly troglomorphic and exhibit wide ranges suggestive of great vagility. Both species are found in most caves throughout southern Indiana.

The second group is comprised of mostly cryptic, mildly troglomorphic arthropods that probably dispersed to BONWR since the last glaciation. Their speciation dates to isolation during the Recent Interglacial period and most are obviously similar to related species, e.g., Pseudosinella undescribed species near fonsa, Onychiurus undescribed species near casus.

In caves of the southcentral Indiana karst a typical site would usually have 10-12 species of troglobites, and the rare “hotspots” of biodiversity attain 20 or more troglobites. Three of these sites have been identified in Indiana, associated with Wyandotte Cave, Binkley Cave and the Lost River System. Due to the number of base niches that are empty in the southeastern Indiana karst no cave exceeds 10 troglobitic species and the highest number at BONWR is eight:

<u>Cave</u>	<u>Troglobites</u>
Gray’s Cave (MF 01)	8
Bernice Chandler Cave (GC 06)	8
Louis Neill Cave (GC 02)	6
Kathryn Bayless Cave (MF 02)	5
Henry Dilk Falls Cave (BC 08)	5
Old Timbers Spring Cave (GC 03)	5
Asa & Sarah Edwards Cave (OC 01)	4
Elmer Turner Cave (BC 03)	3
Ollie Wilson Cave (BC 19)	3

Table 1. Base cave community niches.

	<u>Southcentral Indiana Karst</u>	<u>Big Oaks NWR</u>
Cavefish	<u>Amblyopsis spelaea</u>	absent
Crayfish	<u>Orconectes inermis</u>	absent
Amphipod	<u>Crangonyx</u>	<u>Crangonyx</u>
Isopod	<u>Caecidotea</u>	<u>Caecidotea</u>
Copepod	<u>Diacyclops</u>	<u>Diacyclops</u>
Ostracod	<u>Pseudocandona</u>	<u>Candona</u>
Snail	<u>Antroselates</u>	absent
Flatworm	<u>Sphalloplana weingartneri</u>	<u>Sphalloplana weingartneri</u>
Spider	<u>Phanetta subterranea</u>	<u>Phanetta subterranea</u>
Millipede	<u>Pseudotremia, Scoterpes</u>	absent
Pseudoscorpion	<u>Kleptochthonius</u>	absent
Springtails	<u>Sinella, Arrhopalites</u>	<u>Sinella, Arrhopalites</u>
Dipluran	<u>Litocampa</u>	absent
Beetle	<u>Pseudanophthalmus</u>	absent
Fly	<u>Spelobia tenebrarum</u>	<u>Spelobia tenebrarum</u>

Effects of military use-Certain areas of the BONWR were subjected to bombardment of various sorts. Selected refuge caves and the presence of isopod/amphipod fauna are presented in table 2 (not all caves have adequate aquatic habitat for sampling). Subterranean isopods (Caecidotea spp.) and amphipods (Crangonyx spp.) would be expected in every cave in the refuge with cave stream habitat adequate for inhabitation and sampling. Three caves outside of impact zones and their effects exhibit what are probably normal cave stream faunas for the area.

Within the impact zones, in some cases it appears that caves have collapsed due to the effects of explosives. Examples of this would be Isaiah Irwin Cave (Big Creek 02) or Everett Shonk Cave (GC 05). Isaiah Irwin Cave has no stygobiont organisms in the stream, which flows into the cave from what appears to be a collapsed cave passage, essentially a cave without a roof. Aquatic epigean species are common in the cave's stream. Everett Shonk Cave ends in a breakdown just inside the entrance. This cave is just south of a bombing target area. Stygobionts are also absent in Everett Shonk Cave.

In other caves within the impact zones, a mosaic of presence/absence of fauna was noted. Unlike Isaiah Irwin or Everett Shonk caves, these sites seem to be at least grossly intact. The reason for the absence of fauna remains unknown, but groundwater contamination should be entertained as a cause. In particular, caves in the depleted uranium area (figure 6) appear to have low population densities of stygobiont aquatic species, but quantitative sampling would have to be performed to ascertain this.

Most wells on BONWR are inhabited by the amphipod Crangonyx setodactylus and in some cases, other groundwater species. A well in the Middlefork Creek drainage (section 30 NW ¼) was baited on three occasions with almost no fauna recovered. The well on Middlefork Creek is adjacent to an old landfill, again suggesting groundwater contamination.

Table 2. Correlation of land use with presence of aquatic stygobiont isopods (Caecidotea spp.) and amphipods (Crangonyx spp.).

<u>Caves in non-impact areas</u>	<u>isopods</u>	<u>Amphipods</u>
Sadie & Juanita Jines Cave (BC 18)	present	Present
Old Timbers Spring Cave (GC 03)	present	Present
Bernice Chandler Cave (GC 06)	present	Present
<u>Caves in impact areas</u>		
<u>Middlefork Creek test area:</u>		
Gray's Cave	present	Present
<u>Big Creek test area:</u>		
Charles Bear Cave (BC 01)	present	Present
Isaiah Irwin Cave (BC 02)	absent	Absent
Mary Spurgin Cave (BC 05)	present	Present
Martha Beard Fern Cave (BC 14)	absent	Absent
Edward Prenatt Cave (BC 15)	present	Absent
<u>Depleted Uranium area:</u>		
Henry Dilk Falls Cave (BC 08)	absent	Present
Three Raiders Monument Cave (BC 11)	present	Absent
Ollie Wilson Cave (BC 19)	present	Absent
<u>Area 25</u>		
Louis Neill Cave (GC 02)	present	Present
Everett Shonk Cave (GC 05)	absent	Absent

Figure 6. Caves in the depleted uranium area with possible decreased population densities of stygobiont species.

RECOMMENDATIONS

Some of the habitat for subterranean fauna at Big Oaks National Wildlife Refuge appears to be unharmed, while other parts of the karst terrain have undergone a worst-case management scenario due to their proximity to bombing targets (e.g., Everett Shonk Cave GC 05). With the decommissioning of the proving ground, much of the area is now being allowed to enter a phase of reclamation. The first step in the management of the subterranean fauna of the refuge was completed in 1997, with the culmination of the inventory of the caves of the area by Sheldon (1997).

With the completion of this bioinventory of the subterranean fauna of the refuge the second step of the process has now been completed. The BONWR protects the single largest assemblage of subterranean species found within one management area in the southeastern Indiana karst area.

The next step recommended would be to establish population levels for aquatic species in selected cave streams (e.g., the sites in table 2) similar to what has been done with the Henslow's Sparrow population in the grasslands at the refuge. The most significant animals present at BONWR in terms of state and global rarity are clearly the cavernicolous invertebrates. Establishing population levels would allow long term monitoring, which is of particular importance considering that the fauna is entering a period of potential recovery following probably localized extirpation events. The methodology for this kind of monitoring for cave stream communities has been established by Lewis (2001). Considering the simplicity of the cave stream communities in the refuge, this would be a relatively small project. After initially establishing the protocol for establishing census areas, identifying the animals and counting them, this is a task that refuge personnel could perform periodically.

Several undescribed species were discovered during this project. At least one, Crangonyx undescribed species has already been described in manuscript by Dr. John Holsinger and should become a recognized taxon in the near future. It is recommended that Dr. Janet Reid (copepod crustaceans) and Dr. Kenneth Christiansen (collembolan insects) be funded to prepare and publish descriptions of the new species so that they can be recognized in the future. The Indiana Natural Heritage Program would be an excellent potential partner in this endeavor.

The emphasis of the Sheldon (1997) karst inventory was the discovery and exploration of caves. During the field work for the bioinventory many springs were noted. Consideration should be given to having the cavers revisit their project with an emphasis on cataloging the springs of BONWR to establish the groundwork for a detailed inventory of spring biota.

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The Subterranean Fauna of the Big Oaks National Wildlife Refuge

Final Report to

U. S. Fish and Wildlife Service

Natural Heritage Program

Division of Nature Preserves

Indiana Department of Natural Resources

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